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Contents.

	PAGE
Can We Afford Ford Wages?	139
Exporting Castings	139
British Non-Ferrous Metals Research Association	140
South African Foundries	140
Contracts Open	140
South African Movement to "Buy British"	140
An Australian Founder's Appreciation	140
Imported Wrought Enamelled Hollow-ware	140
Random Shots	140
Reclamation of Foundry Sand	141
Speed and Feeds of Hacksaw Blades	142
Chromium in Cast-Iron Mixtures	143
Reports and Dividends	144
Motor-Driven Testing Machine	144
Catalogues Received	144
Australian Steel-Foundry Practice	145
Sheet and Tinplate Rolls	148
The Economic Utilisation of British Pig-iron Resources	150
Trade Talk	154
Personal	154
Obituary	154
Iron and Steel Markets	156

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Telephone: Central 1085. Telegrams: CIRA.
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Foundry Technical Institute, Meek's Road, Falkirk *(Telephone 332).*

Can We Afford Ford Wages?

We gather that the International Labour Office is making a study of living costs in twelve European countries, so that the Ford organisation may determine what wages must be paid to workmen in the Ford factories at Cork, Dagenham and a number of other European centres, so as to have the same purchasing power as the seven dollars a day paid at Detroit on a five-day week.

The average income of a Ford employee at Detroit, based on a study of 100 families, is £350 per annum, of which two-thirds is used for food, clothing and housing. Now one-fifth of these typical families just balanced income with expenditure and saved nothing. Nearly one-half lived actually beyond their means and had a debit balance of about £26. The remainder, about a third, saved on the average the same sum. We wonder if a study of British working-class families would show half of them in debt? The true test of wages is not how much they amount to, but what they will buy, and here some of the American purchases would be regarded as luxuries—10 per cent. had telephones, 36 per cent. wireless sets, 47 per cent. motor-cars; men and women seem to spend each about £12 per annum on clothes; and the Ford worker is regarded as a more or less envied employee in the United States. These figures do not suggest that, in terms of what it will buy, the American worker is seriously better off than his British counterpart, ruling out of consideration some of the luxury items.

Meanwhile, the lack of social services in that country is evidently causing concern, for the General Electric Company has recently adopted a scheme for unemployment insurance based on equal contributions from the worker and from the company. The participant agrees to pay for three years into a trust fund about 1 per cent. of his earnings, as long as these are over one-half his full-time rate. Of the funds so raised, 3 per cent. is used as a benevolent fund to relieve employees in need, 27 per cent. is available for loan to employees and 70 per cent. is used for unemployment payments. Up to a limit of £4 a week, men laid off temporarily receive half their full-time earnings, the time limit being ten weeks in any period of twelve months.

With this plan the company has attempted to stabilise employment by various means. It increases the force slowly and prefers overtime and transfer from slack departments. It carries out renewal and maintenance work in slack periods. In time of depression, it cuts out overtime, and builds for stock, and, if necessary, cuts the working week down to one-half before laying off men. In the event of men being laid off, family men are given preference and everyone is given proper notice. This sets up a new standard for America, where employment is normally so abundant that hiring and firing is usually of a very casual character.

Thus do we see movements on both sides of the Atlantic, each side endeavouring to approach the other's point of view and practice, and the results will be interesting. In particular, the States wishes to avoid a State unemployment scheme such as we have here.

Exporting Castings.

It is now possible to evaluate the trend of business in the export of British castings for the current year. The light-castings export business has been reduced by about 10 per cent., whilst the pipe trade has suffered about 7½ per cent. loss compared with last year. On the reverse side of the picture is 100 per cent. gain in the export of unmachined steel castings, and 56 in that of iron castings in the rough. In general the figures compare favourably with 1924 and 1925. We have every reason to believe that the export of iron castings will be considerably augmented in the near future, as we are aware of some large orders almost ready for export, but we cannot guarantee that they will enter the Board of Trade classification carrying this caption. If they do they will more than double existing figures. We admit that our remarks on the possibilities of an increase in Australian trade which we made at the beginning of the year have not materialised. They were based on the fact that the clip and crops were particularly good in that Continent last year, but we failed to recognise that market conditions were dead against the economic sale of their produce. Thus we find that exports to Australia this year have been particularly disappointing.

It seems to us that it is imperative that the export trade should be maintained, even though it temporarily results in no profit, because we foresee that, except for specialities, such business in the future will be governed by international cartels, and obviously the quota accorded on formation will be based on *quantity* of past business and not *profit* accruing therefrom. This is a phase of economics not to be lightly dismissed by either the business or the political community; to our mind it ranks with "safeguarding of industries" as a matter of prime importance to the well-being of this country. The cartelisation of international business is no longer a dream, as it has already entered the sphere of practical politics in several directions. Once an international cartel is properly established, it becomes almost independent of politics and even may induce the politicians to become in reality what they are in theory, the servants of the business community, using the word "business" in its widest possible sense.

XUM

British Non-Ferrous Metals Research Association.

The British Non-Ferrous Metals Research Association has secured a leasehold factory property, Regnart Buildings, Euston Street, London, N.W.1, where it is proposed to centralise its offices and provide accommodation for a laboratory and workshops for its research and technical development departments. The Association, founded ten years ago, has made steady progress under the direction of Dr. R. S. Hutton, and now carries out work for all sections of the non-ferrous metal industry on a scale of expenditure of £20,000 to £25,000 per annum. A special appeal for increased annual support and contributions to a Headquarters' Fund has recently been launched and has met with partial success, despite the present difficult industrial conditions.

The Association has already demonstrated its value to industry, particularly in the discovery of new engineering materials and in solving problems of increasing the efficiency of production and of overcoming the causes of defects, matters of great economic importance, which should warrant increased membership and support from the metal and engineering trades.

The British Non-Ferrous Metals Research Association has just enlarged its staff by appointing Dr. D. H. Ingall, D.Sc., as Assistant Director and Research Manager, to take effect from January next. Dr. Ingall is well known for his metallurgical research and administrative work and as first Principal of the Constantine Technical College, Middlesbrough, has been largely responsible for its equipment and organisation. Dr. O. F. Hudson will continue as Senior Metallurgist of the Association. Mr. G. L. Bailey, M.Sc., of the Metallurgy Section, Research Department, Woolwich, has been appointed from September 1 as Development Officer to fill the position recently vacated by Mr. S. J. Nightingale, who resigned to occupy an important position in industry.

South African Foundries.

We are indebted to Mr. Jas. F. Morris, of the Witwatersrand Co-operative Smelting Company, P.O. Box 137, Germiston, Transvaal, for the following additions to the list of South African foundries as set out in Ryland's. The foundry to which he is attached, and Eagle Brass Foundry, Siemart Road, Doornfontein, Johannesburg; Eclipse Tube Mill Liners (Pty.), Limited, Industrial Sites, Benoni, Transvaal; Barratt & Pillans, Krugersdorp, Transvaal; Vulcan Engineering Works, Industrial Sites, Benoni, Transvaal; Union Steel Corporation (of South Africa), Limited, Vereeniging, Transvaal; and Gearings, Limited, Cape Town. There are railway shops at Durban, Germiston, Kimberley, Bloemfontein, East London, Uitenhage and Salt River, and it is known that the last three possess foundries.

Contracts Open.

Darlington, September 11.—Cast-iron pipes, for the Durham County Water Board. Mr. W. Read Ward, clerk, 77, Northgate, Darlington.

Teignmouth, September 1.—Cast-iron surface-water conduit, etc., for the Urban District Council. Mr. F. W. Knight, surveyor and water engineer, Council Offices, Teignmouth. (Fee £1 1s., returnable.)

Wellington, N.Z., September 22.—Two centrifugal sewage pumps, for the Timaru Borough Council. The Department of Overseas Trade. (Reference A.X. 10,097.)

South African Movement to "Buy British."

Welcome evidence of the growing disposition in South Africa to encourage trade between the Union and the United Kingdom is furnished by a movement which has been started in South Africa to "buy British." The movement was originated by two Transvaal farmers, Mr. A. C. Trecise and Mr. M. J. R. Boon, and has taken the form of a publicity campaign in favour of British goods. Its objects may be summarised in a circular, printed in English and in Africaans, which is being distributed to the farmers of the Transvaal. The leaflets are headed "Buy Empire Goods," and read as follow:—

"Great Britain took 72.9 per cent. of the total export of our foodstuffs (including maize) in 1929; farming in South Africa largely depends on the export trade; the market in Great Britain is absolutely vital to us and cannot be replaced. A prosperous Great Britain is going to help to make a prosperous farming industry in South Africa; the British Empire Marketing Board helps us to market our produce in Britain; what do we do to help them market their goods in South Africa? Play the game, buy British machinery and implements, fencing material, tools, motor-cars, tyres, clothing; by buying British you are helping your own export trade and therefore helping yourself; buy Empire goods."

In addition to this campaign by circular, the organisers have raised a fund sufficient to pay for the display of large posters similarly worded to the circulars, at 100 railway stations throughout the agricultural districts of the Union. According to information received from South Africa, this is only one manifestation of a growing desire among South African producers to give preference, whenever possible, to British manufactured goods. It is stated that the movement may extend to other organisations throughout the Union.

An Australian Founder's Appreciation.

Mr. W. T. Main, an ironfoundry owner of Melbourne, Australia, wishes us to express his sincere thanks to all those foundry owners who have permitted him to inspect their works; the President and Council of the Institute of British Foundrymen (which has honoured him by electing him an honorary corresponding member of the Council for Australia); the director and staff of the British Cast Iron Research Association; the foundry-equipment firms which have sent him their catalogues; the various Belgian and German foundrymen, who made his stay in those countries so enjoyable. He sailed last Saturday from Liverpool on the "Ceramic."

Imported Wrought Enamelled Hollow-ware.

The Standing Committee (General Merchandise), appointed by the Board of Trade, have reported on their inquiry as to whether imported wrought enamelled hollow-ware of iron or steel, for domestic (including hospital) use, should be required to bear an indication of origin.

They report in favour of a marking order, it being recommended that the goods, with certain exceptions, should bear an indication of origin, both at the time of importation and of sale or exposure for sale.

Estimating Weight of Iron Castings.—An easy, but most reliable, method of estimating the weight of an iron casting from a drawing, is to take the cubical contents (in cub. in.), add 10 per cent. and divide by 4. This method allows for fillets, etc., and although perhaps not quite correct for very fine reckoning, it is an excellent rule for general purposes.

Random Shots.

The accounts of the new L.M.S. passenger stock on the Euston to Scotland line, and of the new L.N.E.R. sleeping saloons on the Scottish service, gave me a great deal of pleasure, because it indicated progress where some travellers have come by bitter experience almost to despair of progress being made. I am not a railway critic, and I am fully sensible of the difficulties the railways work under to-day, but I sometimes think that the equipment of British lines, especially in stations, is as suited to modern requirements as a Victorian ten-roomed house is suited to the needs of a modern small family. The contractors who are wrecking the Hotel Cecil say it is a difficult job, because the builders apparently built for all time. Thus still do we have to bear some of the worst excesses of building taste that the mind of man ever conceived. We build and make for eternity.

* * *

Had they been less substantial, they might have been replaced long ago. If electric traction were used for hauling trains into the centre of big cities and the smoke nuisance avoided, we should not only get rid of many ugly terminal buildings now used as stations, but the station could be put underground and a large amount of valuable space released for other purposes. Then what about reforming the railway cup of tea and sandwich? Nobody buys either to-day except under press of urgent necessity, yet money could readily be coaxed from the pockets of more sensitive travellers if the fare offered were more inviting. In a lesser degree the same applies to dining-car arrangements.

* * *

A contemporary has been printing a number of letters from readers on the railways, and I felt tempted to join in and criticise that type of passenger who, needing one seat and holding one ticket, carefully drapes his or her belongings over two or more seats. Many people can apparently afford to spend unlimited time in order to save a little money. They can arrive an hour before the train starts and by such lack of consideration inconvenience the business man, often paying full rate for his ticket, who has to catch the train at the last minute.

* * *

Have you seen, either in the flesh or in pictures, the Tom Thumb golf game that is the latest boom from America? Instead of a mere putting green, we now have the whole course in miniature, although all the long shots are eliminated. An eighteen-hole course covers about an acre, and is full of weird and wonderful hazards. It is flood-lighted, of course. New York is said to have over half a hundred of these courses. It resembles some ordinary golf in that one can wait over an hour before getting a round.

* * *

Another American development unlikely to be copied over here is a large and unsightly erection like a switchback railway at a fun fair, over which the rider drives his own car, at his own risk, of course. The other obsession at present, I gather, is Amos and Andy, two white comedians who put negro dialect on the air every evening from a chain of radio stations in the interest of a particular brand of tooth paste.

* * *

It is said that hotels in the States complain that they can do no business while Amos and Andy are "on the air." Cinema managers turn on the loud speaker and suspend the film. Telephone and other business is suspended for the time, and altogether Amos and Andy illustrate a form of mass taste no less characteristic of their country than mass production. But I gather that they are really good.

Marksman.

Reclamation of Foundry Sand.

Of great economic import to some foundries is the question of re-using old sand. The Paper which Mr. Frank Hudson presented to the Middlesbrough Conference, whilst dealing mainly with oil-sand work, detailed the actual position of affairs to-day. The discussion, which we print below, opened up several interesting phases of this development.

Side-Line Utilisation.

In introducing the Paper, Mr. Hudson said that the reclamation of sand was dealt with in the Paper purely to obtain a sand suitable for re-use in oil-sand work. Of course it should be understood that there were other ways of profitably using old oil-sand core material, two of the more important being the incorporation of reclaimed silica sand in ladle-lining composition and the addition of reclaimed silica sand to moulding sands. An exceptionally good refractory lining for all ladles up to 12 tons could be made from 2 parts ganister, 8 parts reclaimed silica sand, and ½ part coke breeze, with a little cow-hair, the whole milled lightly to mix with water. In the case of moulding sands he had, in several cases, added reclaimed silica sand and obtained less defective castings, due to obtaining a more fool-proof sand. This was especially applicable to repetition machine-moulded work in foundries having a standard sand mixture used for hand-rammed jobs. Most machines ram-up moulds far harder than the average skilled moulder, and unless a correct sand mixture is used trouble can be experienced through insufficient use of the vent wire.

Before discussing the Paper it perhaps would be as well to mention that in reference to Table II the transverse strengths of cores using 2 per cent. of binder with new sand were as follow: 41.36 lbs. per sq. in. for Leighton Buzzard and 43.38 lbs. per sq. in. for Southport sea sand.

This only further confirmed the fact that the use of returned core sand without proper reclamation methods only lead to the use of increased binder percentage. In regard to Table III, the sand tested was a steel-foundry sand. It would also be noted that no mention was made in the Paper of reclamation methods using hydraulic means. This phase was gone into quite thoroughly, but the conclusions reached showed positive evidence that it was not a practical foundry proposition.

In this country to-day there was a vital need of knowledge regarding foundry sands and a need for the routine testing of sands in every foundry. In many cases a properly reclaimed sand for use in oil-sand core work was infinitely better than the natural product. It was important to-day for everyone to learn more about sands and sand preparation, and it would be a good thing for the industry when it was understood that far more defective castings were caused through the use of improper sand than ascribed to metal faults.

Old Sand for Lining Ladles.

Mr. A. Sutcliffe referred to the use of ganister for daubing ladles, and said that the lining had a tendency to grow. The lining frequently swelled to such an extent that it rose over the top of the ladle. Had Mr. Hudson had the same experience and could he explain the cause? He also asked if Mr. Hudson could give the cost of lining a ladle. He asked this question because, if a ladle of, say, 8 tons capacity were daubed with ganister, loam or sand, the cost would be different in each case. A small 10-cwt. crane ladle daubed with ganister would last a fortnight without relining, assuming that the ladle was used on alternate days for 10 or 12 times per day; the lining would grow at the top of the ladle every day. He also asked if a cupola lined with ganister would grow in the same way.

Mr. Hudson said that when he was responsible for the lining of ladles the composition which he had given was used for lining all ladles up to 12 tons capacity. A brick bottom was used. The thickness of the lining was 4 in. at the bottom tapering to two inches at the top. The first coat was about 1½ in. thick, and pieces of broken firebrick were pressed into the side when wet. The first coat was dried slowly, and the final coat was then applied and dried. There was a slight expansion of the lining at first, but after the metal had been in the ladle for about five minutes no further expansion occurred. He had no figures with regard to the cost of the lining of a ladle, perhaps Mr. Scott could supply some costs. The reason for using broken firebrick in the walls of the ladle lining was to minimise expansion and contraction.

Mr. W. Scott said he had no figures on the cost of lining ladles, but could get out the cost. He had not noticed any growing of ladle linings, and did not think it was so serious a problem as Mr. Sutcliffe suggested.

Mr. Sutcliffe said that the growing certainly did take place, sometimes to the extent of ¾ in. As this amount of growth takes place in a ladle the depth of which is only 4 to 6 ft., one would assume that there must be a much larger growth in the case of a cupola with a ganister lining.

A Member said it was possible that the temperature of the ladle before tapping into it had an influence on the growth. If the temperature of the ladle was kept high previous to tapping there would be less growth.

Mr. Hudson agreed that this would have some influence on the subject.

Mr. A. Bartlett said that in the South of England it was not usual to use ganister for lining ladles, owing to the cost of transport of the ganister. The practice was to line with firebrick, using loam between the bricks. Provision for venting was made. He thought that there was a growth of ganister linings, but not to the extent suggested by Mr. Sutcliffe. Of course, efficient venting between the ladle and the lining must be done.

Referring to the reclamation of oil sand, he thought that the effects of the oil would not be retained in the new sand mixture. The only use for the reclaimed sand was in the making of loam, and the saving in cost was so little that the reclamation was not justified, and was not worth while. In fact, the only use he had for the waste oil sand was to use it up in the building loam and for loam for making bricks. This ensured that no metal came in contact with the loam made from reclaimed sand.

He did not see how any allowance could be made for the oil contained in the reclaimed sand, the sand mixture would, therefore, be spoiled, with the result that faulty castings might be made.

Mr. Hudson did not agree that the use of reclaimed sand was detrimental, though it depended upon the purpose for which the reclaimed sand was used. The Paper was on the reclamation of oil sand to be used over again for oil-sand work. Most silica sands evolved considerable quantities of gas, but by suitable reclaiming methods most of that gas could be removed.

Potential Methods of Reclamation.

Mr. J. W. Gardom said the cost of the actual sand was small compared with the general costs of core-making. There are many ways of making oil sand cheaper, and a method which would pay in one part of the country would be prohibitive in another district.

There were two methods of reclaiming old sand, namely, mechanically and by washing. A difficulty in using a mechanical separator was due to the core irons. The Hum-mer screen was a good screen, but it required a special current supply. Air separation was costly; he had only seen one plant working, and it required 57 h.p. per ton per hr. He thought that washing was the best method. It was possible to emulsify the oil, and it was easy to grade the sand in the washing process. The difficulties in using reclaimed sand in the main outweighed the advantages.

Reclamation by Washing.

Mr. Hudson said that in estimating the value of reclaiming sand it was necessary to look ahead. At some future date oil-sand cores would be used more than they were to-day. Many of the big foundries were to-day using oil sand for external as well as for internal work, and the question of sand supply will soon be of greater importance. There were two difficulties in connection with hydraulic washing. The first is the fact that the plant required for the reclaiming of oil sand by hydraulic means is costly, and takes up a great deal of floor space in comparison with output. Furthermore, water has no effect on carbonised oil, which was originally the binding medium. In most cases this carbonised oil is insoluble in water. The only means of removing it is by burning it off or by mechanical action. Unquestionably the hydraulic method would grade the sand satisfactorily and would remove clay, silt and other colloidal matter. It must be remembered that the oil is in an entirely different condition after baking and after the core sand his been used than when the oil is first mixed with the sand, and whilst it is feasible to emulsify originally, it is entirely impracticable to emulsify oil after the core has been baked.

Another disadvantage of the hydraulic method of reclaiming sand is due to the fact that it is necessary to remove much of the water after the sand has been reclaimed, and it is necessary to use mechanical dehydration methods or to employ drying apparatus. In the latter case the cost is abnormal due to the large amount of water present. Hydraulic reclamation of sand is feasible for the cleaning of filter-bed sands as used in waterworks schemes and for removing colloidal matter, or for washing moulding and core sands at the quarry. The method suggested by Mr. Gardom has been tried in America but not found at all satisfactory.

In regard to the difficulty suggested by Mr. Gardom of using a mechanical separator caused by the presence of core irons, there are crushing machines designed to-day which handle oil-sand cores containing irons, and it is feasible to obtain the core irons without bending them and without damage to the machine. One of these is illustrated in the Paper.

Magnetic Separation.

Written Communication.

Mr. W. E. Box wrote that he considered the Paper a very good one, and held the view that the reclamation of oil-sand cores was not a practical proposition. The arrangement, however, for the treatment of used foundry sand as shown in Fig. 3, which gives a lay-out of a core-sand reclamation plant, was one which has been adopted by us for the past six years, the first plant having been installed by Tees-side Bridge & Engineering Company, Limited, Middlesbrough. Since that time many similar plants have been installed by various foundries in this country, and, based on the reports he had received from users, these plants definitely pay for the installation and show a considerable saving in the initial cost of sand and in the handling costs.

The object is to provide a bucket elevator as a means for elevating the sand, which, based on recent practice, should be of the belt type and not the chain pattern. Also the boot of the elevator should be flush with the floor so that barrel loads can be tipped automatically without shovel feed. The magnetic separator should always be at the discharge end of the elevator, so that the iron can be separately discharged

(*Continued on page* 142.)

Speed and Feeds of Hacksaw Blades.

The advent of the high-speed steel blade has altered all preconceived ideas as to speeds, weights, and even the design of hacksaw machines. The rules governing the use of tungsten steel blades are well known and need no alteration, but it might be well to recapitulate them so that they can be compared with the efficient running speeds of blades containing 14 per cent. tungsten and over.

The tungsten blade can be aptly described as having a content of between 1 and 2 per cent. tungsten. High-speed steel blades are made from a steel with a tungsten content of from 14 to 18 per cent. and any blades sold with a smaller proportion of tungsten should not be described as "high speed." Blades containing large percentages of alloy but without the requisite percentage of tungsten cannot justifiably carry the description "high speed."

Before stating any speeds, it is necessary to define the meaning of the word "stroke" as applied to hacksaw machines. In speaking of length of stroke the length in one direction only is intended, whereas "X" strokes per minute means "X" complete revolutions of the crank, and the stroke in this instance constitutes a forward and backward movement. This may appear somewhat contradictory, but it must be remembered that a hacksaw blade with vertical-faced teeth only cuts in one direction, and this is probably the cause of the recognised acceptance of the term in the trade. The rules for tungsten-steel blades are set out below.

Hand Blades (Tungsten).

Run slowly, speed not to exceed 60 strokes per minute. Bear hard on the forward stroke so that the blade will not slip, and ease up on the return stroke. The rake of the teeth is always forward. This connotes long even strokes. From tests made, it is found that the average operator exerts a pressure of from 12 to 16 lbs. on the blade, the lighter weight being about correct for a thin blade and the latter for 21-gauge blades. It is quite easy to handsaw at 100 strokes per minute and many a good tungsten saw is ruined thereby and needless complaints ensue from this surplus zeal. The cause of the failure is, of course, that the speed generates sufficient heat at the teeth points to draw the temper of low-tungsten steels.

Machine Blades (Tungsten).

The rules governing their speeds and feeds have to follow the instructions given with the machine in which the blades are used. Machines of light-gravity type generally run on the push or forward stroke at 60 strokes per minute, dry, and the weights are relatively light, as the effect of the push is to bite into the metal being cut. The weights on the blades generally found best are:—For 21-gauge blades 16 lbs. and for 18- to 16-gauge blades 23 lbs. Other types of machines are the return-lift machines, with arrangement for coolant. They are made to-day both to work on the push or forward stroke, the weight being relatively light and adjusted by a spring, or to work on the pull or backward stroke with heavy weight.

Speeds recommended are generally in accordance with the material being cut, and as follow:—Soft steel 100 to 120 strokes per minute and for tool steel 60 to 70 strokes per minute.

Without coolant a limit of 60 strokes per minute is advisable, and this, therefore, determines the speed for cast iron. The weights are ruled by the capacity of the machine. The weight may safely be increased as the saw wears. A little care and observation on the part of the operator is all that is necessary.

Speeds and Feeds for High-Speed Steel Blades.

The term "high speed" means that the steel is capable of running at high speeds without detriment, and not that the blades, run under the same slow conditions as the tungsten blades, will materially shorten the time of the first cut. It will be obvious that a tungsten-steel blade will show quite as good results as the finest high-speed steel blade in cutting butter (to take extremes), and the further the material is remote from softness the greater the benefit by the use of the highest-class blade. For this reason it is doubtful whether on phosphor-bronze, which has an extremely low-hardness reading (such that no Rockwell hardness reading on scale C can be obtained), a high-speed steel hand blade can show results *pro rata* to its relative cost.

In a machine, however, sawing this material at 200 strokes per minute, its sawing speed is amazing, 3-in. planks dropping off in under 60 seconds, a feat unobtainable with ordinary blades. On dense and close-grained materials this super blade outshines its rivals. It is not a question of an extra cut or two as is the difference between the various brands of tungsten blades, but how many times the work of an ordinary blade is multiplied, and ten times is a frequent result.

Speed and Feeds of Hacksaw Blades.

Hacksaws in Foundry Practice have to meet the competition of the Oxygen Burner, Band Saws, Circular Saws and Nibbling Machines, depending on the type of casting and the metal used. From what we have seen of the use of the hacksaw in many Foundries, it has never had a chance to show its potentialities, and this article, which is taken from the "Edgar Allen News," should go far to correct some of the malpractices we have encountered.

High-Speed Steel Hand Blades.

Owing to the feature of red hardness (which means that these blades can be run so fast that blue chips are given off and the temper is not drawn until a temperature of over 600 deg. C. is reached) the most energetic worker will fail to spoil these saws by over-speeding, and it is an interesting fact and one that shows the efficiency of hacksaw blades made from high-speed steel that even red-hot bars can be cut owing to this resistance to temper drawing. Incidentally, this feature can be made use of when bars have to be cut in a hot condition in an emergency such as might arise in the case of fire. There is no doubt that when sawing difficult materials such as stainless and similar steels there is nothing to approach high-speed steel hand blades, and it is chiefly in these cases that the wonderful cutting qualities are made apparent.

High-Speed Machine Blades.

It is probable that high-speed steel blades are more efficient to-day than the majority of machines in which they are run. In one case within recent experience an old-type machine was speeded up and left running in the luncheon hour, the blade cutting beautifully. After lunch, the blade was still perfect, but the machine, alas, was in pieces on the workshop floor, and the demonstrator was far from popular. There are machines, however, that can extend and show the sawing possibilities of these blades. The instruction is, therefore, divided into two groups.

Old-Type Machines.

High-speed steel blades can be safely run without coolant up to 80 strokes per minute with the usual normal weight.

Return-Lift Machines.

In this class of machine the speed may be increased to 120 strokes per minute without coolant, the weight being the normal weight for the machine. When running with coolant the speed may be slightly increased on hard materials, and on mild materials up to 200 strokes per minute, according to the capacity of the machine. The weight can be safely increased 25 per cent. above the normal weight for ordinary tungsten blades, 70 lbs. on 12 in. to 14 in. by 1 in. by 18G by 10T blade being recommended for rapid cutting and long life.

General.

Many are the variations of high-speed steel blades to-day, such as special wide set for grinding and welded edge of high-speed steel. While these may have certain features which may be open to criticism, such as the thickness of the blade and the removal of more material, and the high and uncertain temperature of the weld, there is no doubt that the fact of them being manufactured from high-speed steel makes them more efficient than the ordinary tungsten hacksaw blades. Tests show that high-speed steel blades of standard design, made from first-class 14 to 18 per cent. tungsten steel accurately toothed, set and hardened, generally meet very satisfactorily all workshop conditions.

Reclamation of Foundry Sand.

(*Continued from page* 141.)

into a barrow or jubilee wagon and thus avoid any trouble of digging out the iron from a pit, as shown in Fig. 3 of the Paper.

He did not consider a crusher a suitable application in any case, because, in the first instance, he could design a magnetic separator to take out the iron which may be adhering to a considerable amount of core sand, and secondly, the crusher was always liable to damage due to pieces of iron passing through it.

Screen Separation.

The "Screen" types of separators his firm had recently developed, and which had proved to be very satisfactory, was the jigger type, which jig at a speed of 300 to 400 r.p.m. and were actuated by means of ball-bearing eccentrics, which were also balanced.

In conclusion, it is not desired that these remarks should be taken in any way as destructive criticism, as the writer appreciates that the subject-matter on which your Paper has been written is certainly a difficult one. The writer would also like to point out that he has given up the idea of electric vibratory screen although he has installed one, on account of the electrical weaknesses in such a plant. Similarly the idea of the rotary screen has been discarded for the reasons mentioned in the Paper. He prefers a small complete plant with sifter and magnetic separator, with the discharge positions all above the floor suitable for tipping into a barrow, the whole being completed with an elevator as a means for feeding the material. This plant is quite a recent development, yet three such machines have recently been installed.

Mr. Hudson, in answer to Mr. Box, wrote that the position of the magnetic separator would be decided by the lay-out and design of any particular plant. In many cases it is necessary to use some form of crusher, as hard lumps of cores may have to be broken up, and a magnetic separator would not do this, nor would the separator remove core irons embedded in cores unless the core be crushed first. The crusher as shown in Fig. 1 was mainly included due to the fact that its design is such that cores containing irons (distinct from tramp iron) can be crushed without distorting or bending the core irons and without damage to the machine. However, it should be clearly understood that any designs given in the Paper are only examples, and the best design for any individual foundry can only be arrived at by careful consideration of their particular practice.

Chromium in Cast-Iron Mixtures.*

By T. F. Jennings.

Many interesting Papers, describing the effects of chromium in cast-iron mixtures, have been presented before various technical associations in recent years and have merited the attention of practical foundrymen. A study of these Papers indicates that an enormous amount of work has been involved in this investigation. Results reported by investigators in various sections of this country and in foreign countries are remarkably consistent, considering such varying factors as method and speed of melting, quality and type of charge, sand conditions, etc. Any or all of these factors unquestionably influence the results.

While the present Paper refers only to the effects of chromium, others have recorded the effects of chromium and nickel in various proportions. The ratio of these two elements should be approximately two parts nickel to one part chromium to effect a marked improvement in the strength of grey-iron castings. The silicon content and thickness of section, of course, must be taken into consideration. Considerable improvement in the strength of grey iron can be effected by the addition of either chromium or nickel. Briefly summarised, chromium increases the hardness, strength and wear-resisting properties of grey iron.

Source of Chromium.

In ordinary foundry practice, chromium is added to the charge in the form of ferro-chrome, an alloy of chromium, iron and carbon and a product of the electric furnace. This alloy contains from 60 to 70 per cent. chromium, 4.00 to 7.00 per cent. carbon and the remainder iron. It is a heavy, dense alloy with a silvery fracture, usually is iridescent on the surface and melts in molten iron without much difficulty. Even with small additions of chromium, changed structures of the iron are revealed by microscopic examination. The most perceptible change is in the size of the graphite flakes. Formation of large flakes always is retarded. Depending on the analysis of the iron, as little as 0.25 per cent. chromium sometimes is sufficient to render the iron pearlitic.

This is particularly important in present-day practice, where the trend in all recently improved processes is toward a eutectoidal cast iron. Chromium, when added to molten iron, combines chemically with carbon and iron, thus diminishing the amount of carbon which otherwise would separate as graphite flakes during solidification and which tend to soften the iron and promote an open grain structure. Graphite, as it appears under the microscope, not only is decreased in amount but also is decreased in size. Chromium has more than a hardening effect. Indirectly, it closes the grain as well.

Effect on Carbon.

Formation of chrome-iron carbides at the expense of the graphite occurs with small additions of chromium and gradually increases until little free graphite is found where the chromium content is up to 3.00 per cent. The data of Table I, as given by Piwowarsky, clearly show this effect of chromium in reducing the amount of graphitic carbon regardless of the silicon content.

These chemical analyses not only show the decrease in graphitic carbon with each small addition of chromium, but also show the corresponding increase in combined carbon. This is a point not to be overlooked, as the physical characteristics of the iron, hardness, strength, chilling tendency and resistance to abrasion depend, to a great extent, on the amount of combined carbon present. A gradual improvement in strength accompanies the increase in combined carbon only to the point of eutectic composition, or about 0.80 per cent. of combined carbon. Further additions of chromium convert more of the graphitic carbon to free cementite, the hardening constituent in iron, which accounts for the increase in hardness without corresponding increases in strength beyond certain points.

Table I.—*Effect of Chromium on Carbon Content in Grey Iron (Piwowarsky).*

Si.	Cr.	Gr.	C.C.
Per cent.	Per cent.	Per cent.	Per cent.
1.11	0.00	3.06	0.71
1.06	0.15	2.98	0.63
1.01	0.30	2.97	0.83
1.03	0.51	2.76	0.97
1.82	0.00	3.26	0.44
1.80	0.14	3.23	0.52
1.81	0.28	3.05	0.65
1.68	0.48	2.80	0.80
2.76	0.00	3.45	0.26
2.71	0.14	3.42	0.32
2.74	0.29	3.41	0.33
2.77	0.53	3.20	0.57

Chromium Content of Less than 1 Per Cent.

Investigations have shown that certain limits exist in the quantity of chromium that may be added to cast iron if machinability is to be retained in a given thickness of section. These limits are raised with an increase in the thickness. Some time ago the author conducted a series of experiments in which cast-iron scrap was melted in an ordinary crucible with gradually increasing amounts of ferro-chrome. Each heat was poured into 1-in. dia. test-bars.

With iron containing C, 2.86; Si, 2.72; Mn, 0.50; S, 0.062, and P, 0.794 per cent., the maximum permissible addition of chromium before variation in case of machinability occurred was between 0.52 and 0.63 per cent. Another investigator employed an iron analysing C, 3.16; Si, 1.48; Mn, 0.97; S, 0.054, and P, 0.70 per cent., and found that 0.40 per cent. was the upper limit for chromium content. However, his results probably were influenced by the higher manganese content in the original iron.

These results may be open to criticism because the iron was melted in a crucible rather than in a cupola, and might not be considered a fair representation of what might be expected under different conditions. However, no special precautions were taken to refine the iron before casting. Consequently, it is just as logical to assume that more chromium might be added in regular foundry practice where every factor affecting quality has been carefully controlled before proceeding with the test.

Strength and Ductility.

Transverse strength and deflection usually are augmented by additions of chromium up to about 0.50 per cent., due in part to the refining action of the chromium in preventing separation of large graphite flakes. Where chromium additions between 0.50 per cent. and 1.00 per cent. are desirable and, simultaneously, high-strength iron is necessary, addition of nickel is suggested to restrain the effect of the excess cementite formed. This practice is not uncommon among foundrymen who have given these conditions some thought.

A series of chromium-bearing cast irons made some years ago at one of the leading universities and where the iron was melted in a cupola confirms the foregoing. The results are shown in Table II. Hardness, as shown by Brinell numbers, was included in this summary to dissipate, in a way, a prevalent idea among foundrymen that an addition of more than 0.50 per cent. chromium alone is objectionable from the standpoint of machinability. With a lower silicon content and very light sections this is true; but where the lightest section is 1 in. or more, hardness, as might be expected, is not in proportion to the amount of chromium added. Recently the author examined a block of cast iron 5 in. thick that contained only 0.40 per cent. silicon and 1.68 per cent. chromium. It had been drilled with a $\frac{7}{16}$-in. bit to demonstrate that, although a little difficult, it still was machinable.

Resistance to Oxidation.

Resistance to atmospheric corrosion or oxidation is improved slightly by small additions of chromium, but for a marked improvement more than 1.00 per cent. should be added. Small additions of chromium are advantageous if the castings are to be exposed to high temperatures. The strength at elevated temperatures is improved definitely even with less than 0.40 per cent. chromium. Such small additions prevent softening after prolonged exposure at 925 deg. C. Higher percentages reduce the loss due to oxidation materially.

In addition to these properties, it has been proven that chromium definitely retards castings growth when repeatedly heated and cooled, thus materially improving iron castings used where stresses of this nature are encountered. The writer plans to conduct tests on the use of chromium as an alloying agent in heavy chill blocks that, after repeated use, usually become fire-checked, thereby reducing their life. As the amount of chromium is increased beyond an addition of 1.00 per cent., the hardness is increased very rapidly. Only at rare intervals are alloyed irons found containing between 1.00 per cent. and 3.00 per cent. chromium unless the casting has been designed to resist abrasion in some form or other.

Table II.—*Effect of Chromium on Strength and Ductility of Grey Iron.*

Analysis.						Transverse strength—18-in. centres	Deflection—in., 18-in. centres.	
C	Cr	Si	Mn	S	P			Brinell.
3.74	0.08	2.18	0.53	0.074	0.460	1,892	0.186	156
3.60	0.20	2.35	0.62	0.063	0.474	2,056	0.216	183
3.84	0.35	2.20	0.53	0.057	0.374	2,515	0.233	196
3.92	0.48	2.29	0.48	0.062	0.288	2,498	0.225	212
3.69	0.69	2.02	0.50	0.048	0.364	1,635	0.148	183
3.84	0.81	2.34	0.56	0.057	0.266	1,952	0.256	187

To measure the effect of chromium on volume shrinkage, it was decided to cast relatively heavy blocks (5 by 5 by 25 in.) in sand and weigh them after cooling, assuming that such a procedure would at least indicate the size of the pipe cavity caused by the natural shrinkage of the metal. The results obtained were as follow:

Sample.	Chromium.	Weight.
	Per cent.	Lbs.
A	0.00	78.5
B	0.37	78.0
C	1.68	80.0

From these results it appears that chromium-alloyed irons certainly do not seriously affect the final shrinkage. No way of measuring specific

* A Paper read before the Cleveland Convention of the American Foundrymen's Association. The author is associated with the Utah Copper Company.

gravity was available, but it is reasonable to assume that an iron which contains chromium-iron carbides instead of graphite must be heavier per unit size.

Fluidity Tests.

In attempting to measure fluidity, it was decided to pour several flat castings ½ in. thick about 10 in. square, and reduced in 1½-in. steps to ¼ in. and ⅛ in., respectively, at one end. These were poured with the steps on the cope side and opposite the gate. The results appear in Table III. This home-made method of deter-

Table III.—*Effect of Chromium on Fluidity of Grey Iron.*

Test.	Chromium.	½-in. section.	¼-in. section.	⅛-in. section.
	Per cent.			
A ..	0.00	full	full	full
B ..	0.37	full	full	75%
C ..	1.68	full	full	25%

mining the fluidity, while perhaps unscientific, indicates exactly what we all want to know. Can such thin sections as are met in the foundry be poured successfully? The answer is shown in this chart. The metal must be hotter than ordinary soft iron, as chromium exerts a deadening effect. Iron containing more than 1 per cent. chromium finds its greatest use in abrasion resistance work, which is a problem common in grinding, conveying and crushing machinery. When applied to these problems, with a consideration of its low cost compared with more expensive alloys, its utility and possibilities are readily appreciated.

In view of the relative costs of pig-iron and scrap steel, it is found advantageous to use high percentages of steel scrap. This practice was described by the author some years ago, in a Paper* presented before the American Foundrymen's Association. Two mixes are used, both balanced in respect to chromium and silicon content. These charges, 10 to 12 each day, melt

Table IV.—*Mixtures Used by One Foundry in Casting Grey Iron.*

No. 1.		No. 2.	
Material.	Lbs.	Material.	Lbs.
Steel scrap	3,750	Returned scrap ..	4,000
Soft iron scrap ..	1,250	Soft iron scrap ..	1,000
Ferro-chrome ..	150	Ferro-chrome ..	100
Coke	800	Coke	800
Limestone	150	Limestone ..	150
Purite	20	Purite	20

down with approximately a 20 per cent. chromium loss. The iron is very low in silicon, resulting from the high steel portion of the charge, but this is found to be a very important factor in the quality of the metal. With more silicon the hardness would be lowered, and if any change were considered at all, an increased amount of ferro-chrome would be favoured.

Through the work of other authors and contributors to technical literature, it is found that chromium definitely improves cast iron, first, with an increase in strength and hardness, and second, with higher additions, with a rapid increase in hardness at the sacrifice of ductility. The author is aware of the shortage of more exact data relative to the qualities imparted by this agent, but is firmly convinced that if given a thorough trial with technical supervision, its use will increase rapidly in the future.

Reports and Dividends.

W. H. Dorman & Company, Limited.—Net profit, £5,381, reducing the debit brought in to £40,629.

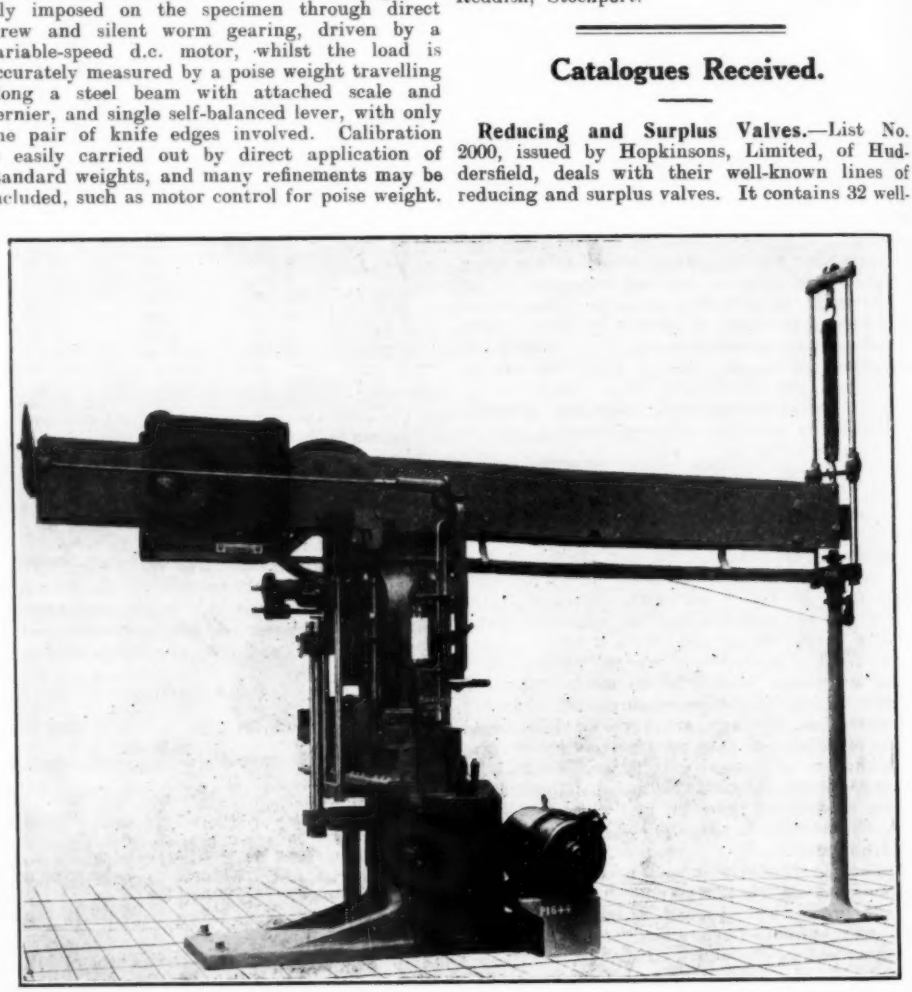
Walter Scott, Limited.—Net profit, £1,302; debit balance brought in, £176,719; interest on 4 per cent. debenture stock for year to June 30, 1930, £12,000; total debit, £187,417.

* "Melting All-Steel Charges in a Cupola Furnace." "Transactions," A.F.A., vol. 34, pp. 1011-1029 (1926).

Motor-Driven Testing Machine.

A RECENT "BUCKTON" DESIGN.

The accompanying illustration shows a 30-ton, motor-driven, vertical, single-lever, "Buckton" testing machine, fitted for testing in tension, compression, deflection, shearing and torsion, and also equipped, as shown, with a spring-balanced autographic-recording device. These machines are made in standard sizes, 10, 15, 30 and 50 tons maximum load. The load is gradually imposed on the specimen through direct screw and silent worm gearing, driven by a variable-speed d.c. motor, whilst the load is accurately measured by a poise weight travelling along a steel beam with attached scale and vernier, and single self-balanced lever, with only one pair of knife edges involved. Calibration is easily carried out by direct application of standard weights, and many refinements may be included, such as motor control for poise weight.



"Buckton" Motor-Driven Vertical Single-Lever Testing Machine.

With regard to some details of the specification of the 30-ton, motor-driven, single-lever, testing machine, specimens are admitted in tension up to a maximum stretched length of 20 in. between grip boxes, which will approach to a minimum distance of ½ in. The poise weight is 10 cwts., caused to travel by hand, and the scale and vernier fitted to the steelyard will read down to 0.01 ton. The Buckton-Wickstead bridle is fitted to ensure that no damage takes place due to shock when a specimen breaks, while the knife edges and their seatings are of specially-treated hard steel, of square section and ground true all over. Also the straining head is driven by a 5-h.p. series-wound reversing motor through tangent gearing, with testing speeds of 0.30 to 3.00 in. per min. An indicating pointer is provided which shows when the steelyard is level, and the grip boxes, which are steel forgings, are of the firm's lever-operated type, with the grips set or released by a single motion of one lever on each grip box.

An ingenious spring-balanced autographic recorder is fitted, which gives a complete graphic record of the behaviour of a specimen under test, on a sheet of squared paper wrapped round a barrel. This is rotated by a tape connected by pulleys with the two crossheads of the testing machine so that the extension of the specimen produces an exactly corresponding rotation of the barrel. Over half a century of experience is represented by these machines, which include vertical and horizontal, single-lever and multi-lever designs, with hand, hydraulic or electric-motor operation.

As is well known, these machines are manufactured by Craven Bros. (Manchester), Limited, Reddish, Stockport.

Catalogues Received.

Reducing and Surplus Valves.—List No. 2000, issued by Hopkinsons, Limited, of Huddersfield, deals with their well-known lines of reducing and surplus valves. It contains 32 well-illustrated pages, private code, and what is most important of all, an invitation to inspect their factory. A covering letter kindly offers this brochure to any of our readers on request.

Hydrogen-Ion Measurements.—The Combridge Instrument Company, Limited, 45, Grosvenor Gardens, London, S.W.1, in List No. 108 describe in detail the apparatus they have devised in this connection for research and other work. Those of our readers interested in corrosion will find much matter of real interest for them amongst the pages of this beautifully-presented brochure.

Steel Sections.—Messrs. Dorman, Long & Company, Limited, of Middlesbrough, have issued a booklet containing in convenient form particulars of their rolling sizes of steel joists, section and plates, together with the extras applicable to any size of joist, angle, channel, tee, etc. It is claimed that the company has the most extensive range of joist and section rolls in Great Britain. Copies may be obtained on application to Dorman, Long & Company, Limited, Middlesbrough.

Australian Steel-Foundry Practice.*

By D. Clark.

Either on account of its remoteness from the great continents of the world, or (shall vials of wrath be poured upon our heads if it is suggested?) due to omissions in elementary-school curriculums, a few misconceptions exist as to the size and potentialities of Australia. It may, therefore, occasion a degree of surprise when it is realised that the respective areas of Australia and the United States are almost equal—approximately 3,000,000 square miles.

The steel foundry was the first branch of the steel industry to be established in Australia. Its beginning was of a very modest character. The pioneers were Smith, Phillips and Dawson, who commenced operations with a small crucible plant at Brunswick, a suburb of Melbourne, Victoria, in the year 1888. Later in the same year and, strangely coincident, also at Brunswick, Davies & Baird (who earlier had been producing iron castings for which they obtained an award at the Melbourne Exhibition in 1888) decided to enlarge their sphere of activities, and became competitors of the aforementioned trio in the field they had opened up.

Entrance of Bessemer Process.

No further development took place until 1897, when a concern, calling themselves The Steel Company of Australia, put down a plant in Melbourne. Their melting unit was what was described as a continuous Bessemer. Like the standard Bessemer, the tuyeres were in the bottom of the vessel.

While occasionally fairly good steel was obtained, on the whole the process proved practically valueless for the regular production of steel of reasonable quality, and as often as not something approaching cast iron resulted. It might be observed, however, in parenthesis, that as fairly good steel was sometimes obtained, it would appear that the technique of the operation was not fully understood.

This company becoming financially embarrassed, its assets and liabilities were taken over by one James Martyn, who in 1906 installed a Tropenas converter. Lack of capital prevented him from procuring the proper plant for producing the blast, and he had to make shift with what he could find within his limited means. He was fortunate, however, in being able to purchase an old locomotive cheaply for the purpose of driving a Roots blower, and by this means provided the necessary air.

Electric Steel Making Commenced.

This probably represented the initial attempt to produce steel castings in Australia fulfilling the requirements of modern specifications. Until 1915 all castings were made by the crucible or converter processes, but that year saw the installation of the first electric unit for the Australian Electric Steel Company, in Sydney, New South Wales.

During the world-war period, development accelerated due to supplies being difficult to procure, and the growth of the industry has since progressed along well-ordered lines. Proof of its expansion is found in the fact that 12,000 tons of steel castings were produced in Australia last year.

The geographical position of the continent and its isolation from the great manufacturing centres of the world make it necessary to become increasingly self-supporting. This fact has been recognised by successive Governments, and a measure of support is given manufacturers by the erection of tariff barriers, when such can be done without unduly prejudicing the interests of the primary producers.

Railway Work Predominates.

While railway and tramway work represents the major portion of the output, the fact that these services are State owned, and are themselves laid out for fulfilling a not inconsiderable proportion of their requirements, forms a serious handicap to private enterprise.

Except under very special circumstances, no Government department can successfully compete upon equal terms with privately-owned concerns in Australia any more than they can elsewhere. This is true simply because the energising spur of competition is absent, and there does not exist the same necessity to key up to the highest efficiency.

Privately-owned railways in general recognise that if profits are to be earned one thing is vitally necessary, and that is to purchase the bulk of their requirements from specialists, not only because this is the policy economy dictates, but because they thus can be reasonably assured of quality and service.

Contact with Other Countries.

That the steel industry in all its ramifications shall be efficient is the settled policy of the manufacturers, and close contact for that purpose is sedulously maintained by frequent visits of administrative and executive representatives to America and Europe. More than this, their experiences are frequently pooled for the benefit of all.

This has been brought about through the instrumentality of the Bureau of Steel Manufacturers of Australia, a body formed primarily for the purpose of discussing manufacturing problems and promoting in general the best interests of the industry. Although only in existence since 1925 it has been of incalculable value, and the high efficiency the industry is fast attaining in every sphere is largely due to its efforts. Men of vision and foresight were responsible for its inauguration, and they conferred a boon not only on the industry *per se*, but, in a wider sense, upon the Commonwealth of Australia.

STANDARDISATION.

While the modern trend toward standardisation is being followed, up to the present this has been mainly confined to quality and physical properties rather than seriously attempting to standardise production. As representing possibly the natural starting point, specifications covering railway requirements were the first to be formulated.

Unfortunately, however, and despite the circumstance that the various State railways are directly represented on the committees, some have introduced specifications of their own. This constitutes a handicap to manufacturers and strikes at the root of standardisation, with its attendant tendencies toward lower costs.

Comparison with American Position.

The automobile industry in America, by standardisation, mechanisation and exploiting mass-production methods to the full, gave a fine lead to the iron and steel founders, who, because of rapidly-increasing markets, were compelled to seek all the aids that standardisation and mechanical appliances could give. These, coupled with payment by results, have placed American manufacturers in a favourable position.

While such conditions do not yet exist in Australia, any more than they did in America at a similar stage of development, it is believed that the former will eventually occupy a position not less advantageous.

Piecework rates or bonus systems are taboo in most trades in Australia, due to the parochial outlook of the strongly-entrenched trade unions. An additional and serious handicap is the existence of a 44-hour working week. While most employers in these days are sympathetic toward the employed in every legitimate effort to improve their conditions, they feel that they also have moral claims for consideration, one of which is that they are entitled to a fair return for money invested.

Basic Wage High.

By comparison, the basic wage in Australia is perhaps the highest in the world. Not content with this, however, efforts are being made to increase it by still further reducing the hours to 40 per week. In common with those countries engaged in the world war, Australia has incurred an enormous debt. Bearing this in mind, employers may surely be pardoned for stating emphatically that a young country such as this, now only in the process of development, cannot afford further flights in the realms of Socialistic experiment. Nor can it continue to have labouring conditions so much in advance of those obtaining in most other countries of the world, unless production is equal (which is impossible).

Successive Labour Governments have so pampered labour in the urban areas that rural workers have migrated thither and created a shortage on the land. The perpetuation of a policy like this does not generally make for the ultimate prosperity of any country, and there seems no reason for believing that Australia will be the exception.

FOUNDRY-APPRENTICE TRAINING.

Boys commence their apprenticeship at the age of 16. The duration of their service is five years, commencing on the core bench, thence to the various moulding machines and finally on floor work. Although it is not compulsory, they are expected to attend the technical school, where they are taught the following subjects:—Practical moulding, theory, trade calculations and drawing. Upon exhibiting a certain proficiency in their studies, their technical education is paid for by their employers, and a record is kept of the progress of each boy for the purpose of review when promotions are being considered.

Close observation has shown generally that when an apprentice becomes careless in his studies, as represented by his college reports, his work in the foundry suffers in like manner. The problem of technical training of apprentices is of vital importance, and it is held that the extent to which this is exploited will govern definitely the growth and efficiency of the industry in Australia.

One disability some non-technically trained moulders suffer from is that they are not adept at reading drawings. In jobbing shops doing a large variety of work, this constitutes a real handicap, and too much responsibility is thereby thrown on to the patternmaker.

STEEL MAKING.

All known processes of manufacturing steel are in vogue for the production of castings. Two plants only make open-hearth steel, namely, The Broken Hill Pty. Company, Limited, and The Australian Iron & Steel Company, Limited, both of whose works are in New South Wales. Either plant is capable of producing castings on a large scale, but as they possess various rolling-mills and large blast-furnace units, the bulk of their foundry production is intended solely for their own consumption rather than the open market.

Electric Furnace Superseding Converter.

Despite the undoubted advantages of the Tropenas converter for foundry purposes, it is being gradually replaced by the electric furnace, which method is capable of producing steel second only to crucible in quality. In most of the foundries operating the electric process, in winter the steel is made during the night for the purpose of evening the load line at the power stations, and, as a consequence, concessions to users are made.

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* Extracted from a Paper presented at the Cleveland Convention of the American Foundrymen's Association on behalf of the Bureau of Steel Manufacturers of Australia.

There are certain disadvantages arising from night melting, one of which is the fact that the moulds fashioned during the day have to lie a considerable length of time before being filled. At all times this is found to be disadvantageous for green work, and in time of high-atmospheric humidity, equally so for dry work. The type of electric furnace mainly in use is the 3-phase 6-ton Héroult, with 115 volts and 7,000 amperes at 25 cycles. The electrodes are 10-in. graphite. The electric supply is obtained from the Government station at 6,600 volts, through a transformer of 1,500 kilovolt-amperes capacity.

Due to the scarcity of low sulphur and phosphorus scrap, the furnaces are basic lined. It is usual to build with magnesite bricks from the bottom to two courses above the breast plates, then a course of chrome bricks, with the upper portion and roof of silica bricks or special firebricks. Electrode holders and frames of charging and tapping doors are water cooled. The bottom and banks are made up of magnesite, chrome ore and slag mixed with hot anhydrous tar, and rammed with hot compressed-air rammers.

Two methods are employed in sintering the hearth, one by burning in the magnesite with coke and broken electrodes, the other by running a small high-carbon heat from specially selected scrap. The latter is quite successful if done carefully, and it saves time. Bottom and bank repairs during the run of the furnace are effected by using dolomite.

Charging Procedure.

In charging, the heavier scrap is first placed in position, then the turnings, and on top, foundry scrap in the form of risers and runners. Limestone is added with the charge in lump form, but is crushed for use during the refining period. When surging is heavy, as happens when the charge contains an undue proportion of heavy scrap, the electrodes are controlled by hand until normal conditions prevail. The whole of the centre of the charge is allowed to melt and become thoroughly hot before attempting to push into the pool the scrap lying around the doors and banks. This increases the speed of working and causes less damage to the furnace banks. When the charge is completely melted, the furnace is tilted forward slightly and the slag run off, a green sapling being used to drive it from the back to the spout. The refining slag is then added and the heat carried to completion in the usual manner.

Pouring Temperature Effect.

No phase in the production of steel castings demands more attention than the question of temperature of the steel at pouring. With so many variables entering into the problem, the solution is not always easy. In deciding upon the temperature to aim for, the analysis of the steel and the number and nature of the jobs to be cast must be considered.

No scientific means of estimating the temperature of the steel before leaving the furnace has proved more reliable, in the writer's opinion, than the old practical method of estimating the time taken for a spoonful of metal to scum over, or, alternatively, from pouring a spoon sample on the floor. Due to the facility with which energy can be provided, electric steel is found liable to greater temperature variations from heat to heat than that steel made by any other process.

While it is common practice to hold the steel in the ladle for a time when poured too hot, it is a matter for speculation whether steel so treated is not already spoiled and can ever be expected to meet the most exacting tests. It will be conceded without dispute that, in the final heat treatment, the finest structure is obtained when the critical point has just been passed, and that increasing increments of temperature beyond that coarsens the grain and detrimentally affects the physical properties. In other words, the grain size obtained is that represented by the maximum temperature reached. Bearing this in mind, is it too much to assume that there is also a critical temperature for molten steel, and that when once this is exceeded, its quality is impaired?

Concerning the problem of temperature at the point of casting, take the case of Hadfield's high-manganese steel. This is a steel which the practical foundryman knows to have an inherently high degree of fluidity. Despite that, it is frequently found too hot both in the furnace and the ladle, with a consequent loss in the efficiency of the ferro-alloy additions. More important than the latter, however, is the quality of the finished product. If cast at varying temperatures, it will be found that the length of the chill crystals formed on the skin of the casting varies with the temperature, being largest when this is highest. It will also be found in the extreme cases that this structure is so persistent that the subsequent standard toughening treatment will fail to remove it. Assuming, then, that there is a casting exhibiting the latter characteristics, and which is subjected to severe bending moment, there is every probability of such fracturing readily, due to the fact that the formation of a crack or cracks is rendered easy at the junction of adjacent crystals and parallel to the major axis. The speed at which cracks grow arising from this cause will depend upon the length of the chill crystals, and their progress will only be retarded at the point where the chill crystals merge into the normal fibrous structure. It is not difficult, then, to foresee that a casting operating under the condition described, particularly one of thin section and poured at an excessive temperature, is likely to have a short life.

Why Steels Fail.

While the phase just discussed concerns casting temperature only, which is always controllable to some extent, there is yet the other aspect mentioned, which is directly associated with the furnace operation and which is probably more vital in all steels irrespective of analysis, and more difficult to determine.

Instances are not lacking—particularly with high-grade steels designed to meet the more difficult specifications—where test or service failures definitely cannot be traced to faulty fabrication, heat treatment or analysis, nor anything which the microscope can reveal after the most minute search. It is possible that the explanation of such failures lies in the fact that there is a definite loss in the properties of a cast of steel when a certain critical temperature has been passed in its manufacture, no matter by what process.

In the production of castings it is probable that some of the losses due to contraction cracks or excessive brittleness are attributable to this. A heat of steel behaving thus abnormally may be truthfully described as having a disease for which there are known palliatives but no absolute cure, and it would appear as if a fruitful field exists for extensive research in this direction.

MOULDING SAND.

In so far as natural sand deposits are concerned, the general conditions in Australia are somewhat analogous to those obtaining in America, in that suitable sands regular in quality do not appear to exist near enough the various foundries nor in sufficient quantities to warrant their exploitation. We do not, therefore, occupy the fortunate position of the British and European foundries, most of which have excellent natural sands within easy reach that can be obtained cheaply and worked up at little cost.

In regard to analysis, the closest approach to the famous Mons deposit in Belgium thus far found in Australia was at Wyee, situated on the main line between Sydney and Newcastle, New South Wales. This sand was tested and compared with the Belgian sand—both in the laboratory and on a practical scale in the foundry—by Vickers-Commonwealth Steel Products, Limited, of Waratah, New South Wales. The respective analyses found are shown in Table I.

The strength of the Wyee sand was excellent, judged by the overhanging test, the results obtained showing 4⅜ in., against 4 in. in the case of the Belgian sand. Comparative sieving tests revealed the Belgian sand to be finer, but under the microscope the grains were found to be somewhat similar in shape.

Table I.—*Comparative Analyses of Australian with Belgian Sand.*

	Belgian. Per cent.	Wyee. Per cent.
SiO_2	91.87	93.13
FeO	2.21	1.14
Al_2O_3	3.02	3.58
TiO_2	0.29	0.21
CaO	0.51	0.07
MgO	0.41	0.03
Loss on heating	1.95	2.13
	100.26	100.29

From the standpoint of analysis and bond strength, it might reasonably be assumed that the Wyee sand was superior to the Belgian, but the practical results in the foundry did not bear this out. Castings of superior finish were obtained from the latter sand. It would thus appear that analysis alone is not sufficient to enable the suitability of sands to be forecast, but that the real factor is the form in which the elements exist. Moreover, natural sands, unless in exceptionally fortunate circumstances, are apt to vary in composition at changing depths and on this account require scrupulous supervision.

The Wyee sand referred to is a case in point. The analysis quoted was that obtained when the sand was first tried in 1927, but results obtained at lower strata proved the silica to have dropped to 72.26 per cent.

Sand Strength Test Questionable.

The remark may be here interposed, on the question of sand analysis, that this is a tedious and costly determination, and it is doubtful whether its value is commensurate with the expense or the time spent on it. The chemical analysis is primarily a guide to refractoriness, while the alumina may be regarded to a certain extent as a measure of the clay and bonding power. It is suggested that the fusion test is really the better index of the refractory value and—combined with a fineness test to indicate permeability and a bond test to gauge strength—enables the foundryman to quickly determine the quality of any sand.

Recently another deposit has been found near Newcastle, N.S.W., which shows early promise. The analysis is shown in Table II. Whether this sand will fulfil all the requirements has yet to be proved, but it is the general tendency to irregularity in natural sands that has compelled Australian foundries to adopt, for the most part, synthetic sands, using as a basis a high-grade silica rock or wind-blown beach sand.

Investigation of Sand Practice.

Recognising the important part that moulding sands play in the success of the foundries, and so that effort would be co-ordinated in investigational work, the Bureau of Steel Manufacturers of Australia, New South Wales State Division, appointed a research committee to investigate the problem. The objects of the re-

Table II.—*Chemical Analysis of an Australian Sand.*

SiO_2, per cent.	89.40
FeO, per cent.	1.49
Al_2O_3, per cent...	6.21
MgO, per cent.	0.10
K_2O ; Na_2O, per cent...	0.08
Loss on ignition, per cent.	2.68
Fusion point, deg. C.	1,737

search were: (1) To investigate sands at present in use; (2) to explore new deposits, and (3) to lay down standard methods of testing.

Questionnaire on Foundry Sands.

As a preliminary step in the work, the committee formulated a questionnaire which was circulated among the foundries of the State, and replies to the following queries were invited: (1) The source of the moulding sand used; (2) method of preparation—(*a*) type of mill; (*b*) time of milling, and (*c*) do you riddle after milling? If so, why? (3) composition of your facing sand for green- and dry-sand work in (*a*) light castings; (*b*) medium castings, and (*c*) heavy castings; (4) moisture content found to produce the best results; (5) the composition of the backing sand; (6) the composition of the core sand; (7) type of melting unit, and (8) is any mould face-wash used? If so, what do you use, and why?

Summary of the Replies Received.

(1) Three distinct types of sand are in use: (*a*) Wind-blown beach sand; (*b*) a natural red sand, and (*c*) friable sandstone, commonly referred to as "rotten rock." The latter type predominates, but any of the three forms the basis of all steel facing sands used in this State.

(2) All prepare their sands in mills, the type only differing in that some have revolving pans while others are fixed. One firm, preparatory to milling, pass their rotten rock through a jaw crusher and crush to about ¾ in. or less. The times of milling range from 5 to 12 min. With regard to sieving, all the replies except one stated that this was done to separate hard, uncrushed nodules. The exception was a firm using sea sand, and sifting in their case was only adopted to break up and aerate the sand.

(3) Generally, about 50 per cent. of returned sand is incorporated in the facing mixture. The thickness of the facing sand used is fairly consistent at from ¾ to 1 in. for light castings, 1 to 1½ in. for medium castings, and 2 in. or over for heavy castings, depending on the size and design.

(4) For dry-sand work the figures run from 5 to 7 per cent.; for green work, 3 per cent. is stated.

(5) As backing sand, returned facing sand is for the most part used.

(6) For small cores, facing sand is generally used; for medium and heavy cores, oil sand.

(7) The melting units are open-hearth and electric only.

(8) All replies indicate that silica face-wash is used, first, to improve the appearance of the skin of the casting, and second, to increase the refractoriness of the mould faces.

PHYSICAL TESTING OF SANDS.

When the research committee commenced work, it was found that no uniform system of physical testing was in vogue, the figures obtained by any one company having, therefore, only a limited value. The committee thereupon investigated the question of suitable standard forms of tests to be applied, and decided that, as the research committee appointed by the American Foundrymen's Association appeared to have done more in the matter of standard routine tests than had been done elsewhere, their methods and equipment should be adopted.

Samples of sand were obtained from the various companies represented on the committee, together with several other deposits within easy reach, and the following investigations carried out: (1) Chemical analysis, (2) fineness test, (3) bond strength with varying moistures, (4) permeability and (5) grain shape.

Reviewing the results, the outstanding features were:—(1) The uniformity of grain size of the Belmont and Botany sea sands, (2) the comparative fineness of the Belgian sand and (3) the similarity among the rotten rocks from Tempe and Gosford.

Trend Towards Synthetic Sands.

While the whole question of facing sands is still *sub judice*, the indications definitely are that synthetic sands make for greater reliability in properties and results. From a refractory point of view, the best base undoubtedly is well-weathered wind-blown sea sand, but the difficulty of finding a suitable binder that will be cheap, and of such a nature that will ensure each individual grain being coated, is not readily surmountable.

The remedy seems to lie in using a naturally bonded sand as the basis and increasing its refractoriness by incorporating a certain amount of sea sand or river gravel. This not only provides a sand of the requisite strength and refractoriness, but the same strict attention to milling does not appear necessary. It is along these lines that Australian foundries believe their sand problems are capable of solution.

While the greater percentage of castings produced in Australia are of the dry-sand type, the amount of green-sand work is steadily increasing. Important as the temperature of the steel undoubtedly is for the successful production of dry-sand work, it is perhaps more so for green sand.

It is found that, except for small work or where very thin sections are concerned, the best green work is obtained when the temperature is at its lowest, say, toward the end of the run and after the dry-sand moulds have been filled. Satisfactory green-sand castings are not only being produced on products of thin section where little or no machining is required, but on fairly large, heavily-proportioned castings requiring a considerable amount of machining.

There is more than a little diversity of opinion as to the relative merits of dry- and green-sand moulds in the production of, for example, railway-wheel centres. The protagonists of dry-sand work assert that it is not possible consistently to produce green-sand castings free from the subcutaneous blowholes sometimes disclosed when machining the surface of the rim.

There appears no doubt, however—with the advent of more efficient methods of sand control, a keener appreciation of the benefits of systematic venting and a realisation of the important part that condition and temperature of the steel itself play in this problem—but that the latter method will be much more extensively adopted.

Types of Work Produced.

As has been indicated, Australian steel foundries are almost entirely engaged on jobbing work, and it is the belief, based on observations abroad, that on work of a general character the standard will bear comparison with that obtained elsewhere.

Indicative of the general types of castings produced by hand moulding are the following:—

Mining.—Haulage wheels, liners, gear wheels, etc.

Quarries.—Excavator replacements, bucket teeth, rock-crushing machinery, roller shells, pathway plates, etc.

Tramways.—Special trackwork, manganese steel switches and crossings.

Railways.—Locomotive-wheel centres; carriage and wagon castings, such as bolsters, side frames, etc.

Machine Moulding in Wide Use.

As to machine moulding, while a large number of miscellaneous carriage and wagon castings—such as axle boxes, side frames, etc., and colliery skip wheels—are made in this manner, the preponderance of machine work is represented by carriage and wagon-wheel centres. Jolt, ram and turnover machines are in general use, although the smallest wheel centres are being made on hydraulic squeeze machines. The machines are usually served by a crew of three, including a moulder, a labourer and a finisher.

Casting Wheel Centres.

With regard to the casting of wheel centres and the like, the horn type of runner, entering at the underside of the boss, has given complete satisfaction in some plants. Its position readily permits removal and in no way interferes with the machined surfaces.

This runner allows the use of full-sized risers of the enclosed type, but at the cost of reduced metal recovery. Most plants, however, favour the open-half riser, which also serves as the pouring point for the metal. This method is simpler and has the advantage of yielding a higher recovery. Nevertheless, there are disadvantages, among which is the greater risk of causing erosion of the mould, consequent upon the fall of the metal on the sand face. This is liable to produce sand pockets, which may result in increased dressing and higher machining costs. When the erosion is severe, the free sand so displaced generally becomes entrapped under the ledge forming the boss face diametrically opposite the riser.

Concerning the full head, the main disabilities arising from this lie not only in the reduced metal recovery but also in the increased cost of its removal and the necessity for a larger core. On the other hand, in addition to the comparative freedom from sand on the boss face, the enclosed head improves the feeding properties by retarding the freezing of the metal. It also eliminates the necessity for utilising studs for the purpose of centralising the core, and in lieu thereof a core print on the cope is provided.

Removal of Gases.

Referring now to the question of venting, it would appear that this aspect is deserving of greater attention than it receives generally, and is capable of more intelligent application. Consideration of the physical conditions prevailing within a mould, from the first entry of the metal to ultimate solidification, reveals several problems upon the successful solution of which depends to some extent the quality of the foundry product.

Apart from contraction—to minimise which effect the steel moulder has to allow for the natural shrinkage if tearing is to be avoided—there is the matter of providing for the removal of gases that may be evolved from the sand or metal, and in addition, the displacement of air within the mould. The elimination of these baneful but unavoidable elements, not only requires consideration of the influence of design and the positioning of risers, but also the important part that venting plays.

The gases liberated earliest tend to collect at points of minimum pressure and maximum temperature, which in the latter case will be where the section is greatest. It is for that reason that the experienced moulder will always place the heaviest section at the lowest position in the mould whenever possible, and will provide adequate risers, suitably positioned and designed, to ensure not only the maximum pressure but also elimination of gases and contained air.

Mould Surfaces.

Reverting now to the surfaces of the castings, it is probable that the gas from the mould itself is liberated before the maximum evolution from the metal commences, and that it occurs when the latter is in a weak condition. Hence it is evident that, unless the facing sand is sufficiently permeable and unless ample artificial vents are provided to ensure the unrestricted passage of air and gas from the sand when the pressure is at the maximum, part is liable to pass into the steel, producing an unfavourable condition likely to be accentuated later when the gas given up by the metal comes into play.

In the case of plate work particularly, it is necessary to have the facing sand highly permeable, and, furthermore, to provide all the vent holes possible in the backing sand. Otherwise, the production of castings free from gas holes and surface blemishes is found to be impossible.

The moulds for all castings with large flat surfaces should be amply vented from the inside with a small wire or rod, then carefully finished.

(*Continued on p.* 149.)

Sheet and Tinplate Rolls.

ROLL BREAKAGE AND TEMPERATURE CONTROL.

At a meeting of the South Wales Institute of Engineers, held at Swansea recently, Mr. J. Selwyn Caswell, M.Sc., A.M.I.Mech.E., presented a voluminous Paper on "Sheet and Tinplate Rolls," being an investigation into the roll loads, stresses, and the causes of roll breakage. The principal ground covered by this interesting and valuable contribution included: (1) Roll-breakage records, (2) temperature variations in the mills, (3) loads carried by sheet and tinplate rolls, (4) loads set up by the deformation of the iron, (5) torsional loads, (6) physical properties of grey and chilled-roll iron, (7) magnitude and variation of the stresses in the rolls, (8) haircracks and firemarks on the faces of fracture. We append a few extracts from the Paper, and an extract from the discussion which took place thereon:—

Roll-Breakage Records.

It was considered that a representative record of roll breakages would provide interesting, as well as useful, information in this investigation. The Welsh Plate and Sheet Manufacturers' Association very kindly co-operated with the writer for the purpose of obtaining a suitable record. Returns were collected during the whole of the year 1928. The number of broken rolls represented by the returns was 182, and the mill units concerned were respectively 29 sheet mills and 28 tinplate mills. The record was not, unfortunately, as large as one would wish it to be, but it was the largest record which could be obtained in the circumstances.

The conclusions which are suggested by the returns are as follow: (1) For tinplate mills, the ratio: $\frac{\text{Number of rolls broken annually}}{\text{Number of mills}} =$ approximately 1.8; and in the case of sheet mills the value of the ratio is 4.0. According to Ryland's Directory (1926) there were 390 sheet mills and 515 tinplate mills in this country, and if it is assumed that 65 per cent. of these are continuously at work, the total number of rolls broken annually for the whole of the sheet and tinplate trade in this country is 1,600 approximately, of which 1,000 are sheet-mill rolls and 600 are tinplate-mill rolls. (2) A greater number of rolls are broken during the winter months than during the summer months. (3) Most of the rolls are broken during the three days Tuesday, Wednesday and Thursday, and the greatest number of rolls are broken on Tuesday. (4) There is little difference between the number of rolls broken on each shift. (5) There appears to be no part of any shift at which the liability to roll breakage is greater than at any other part of the shift. (6) Roll breakages are more frequent with large-diameter rolls. (7) The average life of a tinplate roll appears to depend more on the life of the chill than on the occurrence of breakage, and worn finishing rolls are used for considerable periods in the roughing mills. The average life, as given by returns, is eight weeks. (8) It appears that the life of sheet-mill rolls depends mainly on the occurrence of breakage, and the returns indicate that the working life of these rolls averages eight weeks. (9) The greatest number of rolls are broken on the "parts" shown below: Sheet mills (in which the same pair of rolls is used for roughing and finishing). Thick iron, "fours" (matching fours), "sixes" and matching of "sixes." Tinplate mills (separate mills for roughing and finishing). "Singles," "fours" and "eights."

(10) Eighty-three per cent. of the rolls were broken on first runs. (11) Thirty-four per cent. of the rolls were broken during the first run on matching of the pieces, and nearly the whole of these breakages occurred on the matching of the thick iron, "fours" and "sixes," in the sheet mills. (12) The last two conclusions suggest that modification, or more stringent control, of the drafting or screwing is desirable. (13) About an equal number of top and bottom rolls are broken. (14) Eighty-four per cent. (of a total of 87 rolls for which the records are complete) of the rolls broken during a twelvemonth in the sheet mills of one of the co-operating works showed haircrack marks on the fractured faces of the rolls. (15) Eighty-two per cent. of the roll breakages take place through the body of the roll, and only 14 per cent. take place from the neck to the body of the roll, while the remaining 4 per cent. are fractures by spalling or torsion fractures of the necks or wobblers.

Loads Set up by the Deformation of the Iron.

The value of the resistance of the material to deformation depends on the following: Average temperature of the iron, draught, width of the piece, speed of rolling.

The author believes that the following represent the maximum cut-bar lengths in a large number of mills:—Sheet mills: Cut bars, 37½ in. long, for sheets 36 in. wide. Tinplate mills: Cut bars, 20½ in. long, for plates 20 in. wide.

The maximum draughts are nominally ⅛ in., but the draughts recorded in tables indicate that the draughts may be considerably more. It may be concluded that the approximate maximum loads, which may be set up on sheet and tinplate rolls on the bar lengths referred to above, are as follow:

Mill.	Length of bar or widest iron between rolls.	Draught.	Maximum loads.
	Inches.	Inches.	Tons.
Tinplate mill—			
Roughing ..	20½	0.223	500
Finishing ..	20⅝	0.079	420
Sheet mill	37½	0.20	1,140

The torsional loads in a train of sheet or tinplate mills will vary between the limits, friction load only, and the friction load plus the rolling load, and the maximum torque would be set up, when all the mills in the train would be simultaneously rolling the heaviest pass. Regarding the probable maximum torque set up by a train of tinplate mills, there are usually three or four mills in a train, and a train may be placed on one side or on each side of the flywheel shaft. It has been assumed below that there are four mills in the train. There are, therefore, four roughing mills and four finishing mills.

If all the mills are simultaneously engaged on bars, and if the rollermen roll the first run at the same time, the torque set up would be as follows:

	Inch-tons.
Maximum torque for turning four roughing mills, rolling the first run on bars	4 × 1,400 = 5,600
Torque required to turn the four empty finishing mills (based on 15 h.p. per mill at 40 r.p.m.) ..	4 × 10.5 = 42
Total torque for the whole mill train	= 5,642

A more representative maximum load condition would be simultaneous rolling of the first run on bars in two mills, and simultaneous rolling of "eights" in the other two mills.

Under these conditions the maximum torque set up by the whole train of mills is then:

	Inch-tons.
Maximum torque for turning two roughing mills, rolling first-pass, bars simultaneously	2 × 1,400 = 2,800
Torque for turning two finishing mills, rolling first run on "eights," simultaneously (calculated as for bars)	2 × 830 = 1,660
Torque required to turn two empty roughing mills (18 h.p. at 40 r.p.m.)	2 × 12.5 = 25
Torque to turn two empty finishing mills (15 h.p. at 40 r.p.m.) ..	2 × 10.5 = 21
Total torque for the whole mill	= 4,506

It may be concluded, therefore, that a tinplate-mill roll may be subjected to a torsional load of approximately 5,000 in.-tons.

The values of the inclination of the principal planes are based on the previously assumed condition that the stresses due to the applied loads are the only stresses in the roll. The other stresses set up in the roll are those due to cooling strains in the foundry and the thermal variations which occur when rolling is in progress.

The effect of these other stresses will be to reduce the angle of the inclination of the principal plane of tension, and thus cause a plane of fracture to become more nearly perpendicular to the centre line of the roll.

The plane of fracture is altered, however, when haircracks are present, and the cracks become the starting-points of fracture irrespective of their position relative to the principal plane of tension.

Roll Temperature.

Under the heading of "Stresses set up by Thermal Strains," the author discusses the effect of irregular working, and gives a chart relating to a particular mill, which shows that during the early part of the shift the "heats" were put through the rolls at a rapid rate, with the result that the mean roll temperature rose considerably above that which prevailed during the previous shift. A similar rise which occurred a fortnight before was immediately followed by fracture of one of the rolls in the mill.

A common expression in the industry is "the rolls go down towards the end of the week," and it refers to the change which takes place in the sweep of the roll. The common method of correcting the sweep is to turn water on the necks, and it is of interest to note here that the colloquial explanation of its effect is "to drive heat into the roll," but this is, of course, only the apparent effect. The necessity of maintaining the sweep during the whole of the week suggests that more rapid working of the heats during the later stages of the week would be a convenient method of keeping the rolls to the correct sweep, and it is a view which is held by some rollermen.

While the slightly cooler condition of the rolls would allow this to be done to a small extent, it is a method which is accompanied by considerable risk, principally because the increase of the mean temperature of the face would be such that an adverse change of the stress conditions in the outer and the intermediate zones would be produced.

Thermal Variations with a Falling Face Temperature.

Referring to the effect of the cooling between the rolling periods, the author states that the greatest stress changes will occur during the longest period, and such periods usually occur between the heats. The duration of the intervals between the rolling periods varies considerably according to the mill practice regarding the taking of meals and the changing of shifts, and there appears to be no doubt that irregular working during a shift and the long intervals between shifts play a considerable part in causing the ultimate failure of a roll. If

the cooling period is relatively long, the stress changes take place over a greater depth of the roll.

During a cooling period, reversal of the temperature conditions takes place in the outer zone, and instead of there being a temperature gradient from the face inwards, there is a temperature gradient towards the surface from some point below the surface, and the position of the point moves gradually toward the centre of the roll. Cooling of the outer zone tends to produce contraction of this zone, but contraction is resisted by the hotter underlayers. Such conditions would tend, therefore, to set up tension in the outer layer and compression in the underlayers.

The tensile stresses which are set up would gradually increase in value during the interval between the passes, and the temperature changes would penetrate deeper into the roll, thus producing increasing tension in the outer zone and tension over an increasing annular area below the surface of the roll. The development of these tensile stresses in the outer zone brings the roll into a dangerous condition, because they diminish the reserve tensile strength remaining in this zone for carrying the tensile stresses which are subsequently set up when rolling is in progress.

The first part of a heat imposes the greatest rolling load stresses on the roll, and if the cooling period has been relatively long, the roll commences to work the next heat under the disadvantages of: (*a*) Diminished tensile strength, *i.e.*, reserve strength; (*b*) the necessity of carrying the greatest rolling load stresses at the outset.

N.B.—On this point, it is interesting to notice that the roll breakage returns show that 83 per cent. of the rolls were broken on first run passes.

It is not improbable, therefore, that fracture of the roll may occur soon after one of these cooling periods, or if not fractured, a crack may be produced, and the remaining life of the roll is at once shortened. The presence of a crack is a factor which may render the roll liable to fracture at any time of the week, and when fracture does occur it is difficult to trace the original cause of the fracture. This is one of the factors which the collection of a large number of roll breakages was intended to eliminate.

There is reason to believe that the most serious stress conditions would be set up during the rolling period immediately following the cooling interval, or it may be concluded that the most serious internal stress conditions are set up during the cooling period, and that any means of preventing loss of heat during this period will delay the development of these conditions. It should not be concluded, however, that the stress condition becomes more serious as cooling proceeds. The temperature records and the changes in the temperature gradient suggest that the most serious conditions are set up within the first half-hour. During this period there are sharp changes in the temperature gradient and the stress conditions in the outer zone. As cooling proceeds, the cooling effects are distributed over a greater depth and the changes in the stress conditions take place at a slower rate. The net effect of this would probably be to produce a less dangerous condition.

It is probable that the seat of the trouble occasioned by the breakage of a sound roll lies in the variations of the stress conditions in the outer zone of the roll. The foundry methods decide the internal stress condition in this zone, and the subsequent changes in this zone depend on the way in which the rolls are used.

DISCUSSION.

Mr. H. Spence Thomas said he reckoned the direct cost of rolls to the tinplate trade in Wales to be about £4,000 per week, or £200,000 a year in actual cash, and there were many present engaged in the manipulation of rolls in the works, where much of that vast sum was being probably wasted. Personally, he looked upon the roll as the most fickle and troublesome unit in the works. A hundred years ago the diameter of the rolls at Melingriffith was 14 in. They were made in Bristol. It was then the custom for the foreman to keep the secrets of his mill within his own family, and in order to perpetuate that tradition each mill was lodged in its own separate house, which no one but the foreman and members of his family were allowed to enter and pry for information. It was not a wise custom; nevertheless, they must give credit to the old pioneers for obtaining such remarkable results without the technical and scientific knowledge now at the disposal of everyone in the trade.

The author had stated that most of the breakages of the rolls occurred during the first run. He agreed; but he would like to know whether it was the first run in the "part" or in the "heat" or in the "pass" that was the cause of the breakages. He also agreed that the rolls should have time for seasoning or weathering, especially when they understood the terrific stresses set up internally in the great mass of metal during the cooling process.

Roll Temperatures.

Continuing, the speaker said the temperatures quoted in the Paper were surface temperatures, and the temperatures in the body of the roll had to be assumed. He did not like the possible errors involved in that assumption, and he would be glad if Mr. Caswell would endeavour to obtain the actual temperatures at various depths in the body of the roll in relation to the surface temperatures. He saw investigations on those lines carried on in America in 1914 by boring a hole from the radius diagonally to the centre; and by means of a thermo-coupling, which gave contact between the internal stages and the radius, it was possible to obtain the temperatures at the various points of the whole body of the mass of metal at one and the same time. He could not imagine that the heat on the surface had any relation to the heat in the centre of the mass, and there were means by which air could be blown into the body in such a way as to assist in the cooling of the whole mass, and in lessening the considerable lag between the surface and internal temperatures.

Then, again, as the strength of the roll was put at 11 tons per sq. in., it would be interesting to know whether that was at a normal air temperature of 60 to 70 deg. Fah., or at high working temperature, because cast iron would have different strengths at different temperatures. He assumed that the lower the temperature at which the rolls could be worked, the greater the strength of the rolls and the better the quality of the sheets.

Control of Roll Temperature.

The speaker also agreed with the author that in many works the rolls were treated abominably instead of being prepared by pre-heating prior to working. If it were possible to cast a roll with a hole run through it, many of the initial strains and troubles owing to heating and contracting would be lessened considerably, but the author had shown that there were great difficulties in that direction that had hitherto made the attempts unsuccessful. To get good results it was vital to have control of roll temperature, and all the agencies now used, such as water and steam, were only applicable externally to the surface of the roll. Some time ago he had a 4-in. hole bored through a roll from end to end, but he was not able at that time to follow up the experiment thoroughly. It might, however, be found that extracting the heat from the body of the roll in that way, and keeping it uniformly cool, they could reduce the enormous variations of temperature upon the surface of a chilled roll, which acted as a band around the main cylinder. It would not cost much, with modern machinery, to bore a hole, if it were proved to be of any use.

Continuous working of the rolls from start to finish was essential. Idle intervals were fatal to mill rolls, and when in India recently he was much impressed by the steadiness of the output of black plates of excellent quality and the maintenance of a low roll temperature.

Mr. S. R. Cound said that he had gathered the impression from Mr. Caswell's *résumé* that the author put most of the blame on the rolling mill, and thought that by getting rid of haircracks they would get rid of the breakages.

Mr. Frederick J. Taylor said they were told a great deal about developments in the tinplate trade in other countries, but he ventured to question whether they were more backward in South Wales than anywhere else. Whatever might be said about the roll makers of Wales and their products, it was an interesting fact that Germany and other countries still came to Wales for their rolls.

Mr. Caswell said that if his brief *résumé* of the Paper had given the impression that he was putting the whole of the blame for breakages on the foundry, he wished to remove that impression and to ask that the Paper itself be studied, because he had tried to point out that it was possible to reproduce in the mills conditions similar to those that obtained in the foundry, and that it was not impossible to produce haircracks in the mills.

Careless Mill Work and Roll Breakages.

Mr. Elwyn Morris, speaking as a foundryman with some knowledge of tinplates, said that Mr. Caswell had evidently gathered his facts in works where the mill work was well done. His diagram of temperatures appeared to show that the heating of the iron had been very uniform. It would be useful to know what additional strain was set up in the rolls where the mill work was careless and where the piece came out of the furnace at a very unequal temperature. Such an investigation would show that careless mill work frequently resulted in roll breakages.

Heat Loads.

Mr. A. Corbin said Mr. Caswell had arrived at an approximate figure for the loads on the rolling mills, but he could not find any figures in the Paper for the heat loads and the various other factors that went to make up the total load on the roll. He would like to see some resultant figures of those various strains. They were given the figure of 4 tons, but, in his opinion, there were other strains equal to at least another couple of tons, which brought the total strain dangerously near to the ultimate strength of the material of which the roll was made. He did not know of any component in any branch of manufacture that had so low a factor of safety as a tinplate roll running under normal conditions, and when the conditions of rolling were somewhat abnormal, it was marvellous that it stood the strain as long as it did. Mr. Caswell had emphasised the effects of haircracks and of cooling stresses when the rolls were standing, but he had also told them of an instance where, by proper control of the heating and other precautions, there had been no breakages for nine months. If such a result could be obtained simply by controlling the heating of the rolls, why bother so much about anything else? Nine months was a remarkably long life for any roll.

Australian Steel-Foundry Practice.

(*Continued from p.* 147.)

Necessity of Proper Venting.

Except in limited instances, steel moulders generally have a certain lack of appreciation of the efficacy of adequate venting, and a failure to grasp the fact that a number of strategically or wisely placed vent holes bring their reward in the shape of better quality castings, with fewer surface defects disclosed on machining. Any cases where venting is apparently ineffective can usually be traced to lack of care in leading off the vents, as blind or choked vents may easily produce a condition more unfavourable than their complete absence.

Concerning annealing practice, some Australian foundries favour oil-fired furnaces with the double truck. When handling castings of a general character, the idle truck is fully charged and run in when the truck load under heat is withdrawn. The full annealing temperature in the furnace is maintained all the time, and departure from this procedure is only made when castings of intricate design are involved. In such cases they are allowed to cool off slowly in the furnace. While this Paper is intended mainly as a general outline of the activities and practice obtaining in Australian steel foundries, it is hoped that it is sufficiently adequate to convey some idea of the rise and increasing importance of the foundry industry in Australia. If the author has successfully fulfilled this condition, then he will be amply repaid for any trouble he has taken.

The Economic Utilisation of British Pig-Iron Resources.

(*Continued from page* 116.)

District "J"—Northamptonshire—*continued.*

Index No.	Firm or Works.	Type.	Designation, Grade or Brand.		COMPOSITION. C. Combd.	C. Gr.	C. Total.	Si.	S.	P.	Mn.	Other Constituents.	Remarks.
61	WELLINGBORO' IRON CO., LTD., WELLINGBORO'.	(H)	No. 1	A	0·050	3·608	3·658	3·39	0·010	1·624	0·374	—	—
		(H)	No. 2	A	0·066	3·472	3·538	3·35	0·010	1·678	0·330	—	—
		(H)	No. 3	A	0·116	3·520	3·636	3·290	0·010	1·591	0·341	—	—
		(H)	No. 4	A	0·120	3·187	3·307	3·250	0·020	1·645	0·319	—	—
		(H)	(High Silicon) Silky	A	0·088	3·168	3·256	4·670	0·022	1·624	0·363	—	—
		(H)	Forge	A	0·237	2·910	3·147	2·500	0·040	1·637	0·286	—	—
62	LLOYDS IRONSTONE CO., LTD., Corby, near KETTERING.	H	Nos. 1, 2, 3 Foundry and Grey Silky	A–R	trace—0·08	2·8—3·15	(2·8—3·23)	2·75—5·00	0·02 max.	1·60	0·35	—	Silicon and carbon vary between these limits according to fracture specified.
		H	No. 4 Foundry	A–R	0·10	3·00	3·10	2·5—3·25	0·04 max.	1·60	0·35	—	
		H	Close Iron	A–R	0·50	2·50	3·00	2·0—3·0	0·05 max.	1·60	0·35	—	
63	HUNSBURY IRON CO.	—	Out of blast since 1921.										
64	UNITED STEEL CO., LTD., WELLINGBORO'	—	No reply. Furnaces out of commission both quarters.										

District "K"—North Staffordshire.

65	MIDLAND COAL, COKE & IRON CO., LTD., Apedale, NEWCASTLE, STAFFS. *Head Office:* British Pigirons, Ltd., Abbey House, 2, Victoria Street, London, S.W.1.	(H)	MIDHILL Selected All Mine Special Cylinder	R	—	—	2·80—3·40*	0·60—3·00	0·06—0·08	0·50—1·30	0·60—1·50	—	* Total carbon "according to grade."
		(H)	GLENHILL All Mine Special Foundry	R	—	—	—	2·0—3·00	0·02—0·04	0·50—0·60	1·00—1·25	—	"Supplied to buyers' specification within the above limits."
			British Pigirons, May 23, say :— "In future these brands to be manufactured by the Trent Iron Co., Ltd." (No. 54 "H"—Lincolnshire.)										
66 & 67	SETTLE, SPEAKMAN & CO., LTD., whose principals are STAFFORD COAL & IRON CO., STOKE-ON-TRENT.	H	FENTON No. 1 Foundry	R	0·25—0·40	3·0—3·30	—	2·8—3·3	0·02—0·035	1·2—1·35	1·5—1·85	—	—
		H	,, No. 3 Grey	R	0·45—0·65	2·60—2·80	—	2·50—3·00	0·025—0·040	1·2—1·35	1·4—1·65	—	—
		H	,, No. 3 Ord.	R	0·55—0·75	2·60—2·70	—	2·20—2·65	0·035—0·050	1·2—1·35	1·4—1·65	—	—
		H	LOMOND No. 3	R	0·45—0·75	2·60—3·00	—	2·50—3·50	0·015—0·030	0·50—0·80	0·60—1·00	—	—
		H	FENTON Foundry Manganese	R	0·45—0·65	2·60—2·80	—	2·50—3·00	0·025—0·040	1·2—1·35	1·9—2·10	—	—
		H	,, Siliceous	R	0·10—0·25	2·90—3·10	—	4·0—4·50	0·015—0·031	1·2—1·35	1·4—1·70	—	—
68	SHELTON IRON, STEEL & COAL CO., LTD.	—	"Not now making foundry pig-iron, therefore have no useful information which we could offer you."										
69	NORTON & BIDDULPH COLLIERIES, LTD., Biddulph, STOKE-ON-TRENT.	—	"We have acquired the North Staffordshire works of Messrs. Robert Heath & Low Moor, Ltd., but our blast furnaces are not working, and there is no prospect whatever of resumption of operations."										
70	GOLDENDALE IRON C.O, LTD., TUNSTALL.	—	Shown as not working September 30, but working December 31, 1929.										

District "L"—South Staffordshire.

C.O, LTD., TUNSTALL.

District "L"—South Staffordshire.

Index No.	Firm or Works.	Type.	Designation, Grade or Brand.		COMPOSITION. C. Combd.	C. Gr.	C. Total.	Si.	S.	P.	Mn.	Other Constituents.	Remarks.
71	G. & R. THOMAS, LTD., HATHERTON.		No reply.										
72	EARL OF DUDLEY'S ROUND OAK WORKS, BRIERLEY HILL.	C	"L.N. F'CES DUD."	A	**0·60**	**2·65**	**3·25**	**0·85**	**0·09**	**0·48**	**0·65**	—	"Open top. Supplied for the manufacture of chilled rolls and heavy engineering castings where great strength is required. Average tensile strength 15–17 tons per sq. in. Transverse, 40 cwts. on 2 in. by 1 in. by 3 ft. centres."
		C	,, ,, ...	R	0·50—1·20	2·35—2·90	3·0—3·40	0·60—1·80	0·06—0·18	0·40—0·57	0·50—0·85	—	
					Supplied in nine grades.								
73	ALFRED HICKMAN, branch of Stewarts & Lloyds, Ltd.	—	—		"We are only makers of basic pig, mainly for our own use." No particulars supplied.								
74	M. & W. GRAZEBROOK, DUDLEY, WORCS.	C	No. 3	A	**0·4**	**2·9**	**3·3**	**1·2**	**0·06**	**0·5**	**0·8**	As, Cu, Cr, Ni, etc., nil	"Genuine cold-blast South Staffordshire All Mine."
		C	,, 3	R	0·4	2·9—3·1	3·3—3·5	1·2—1·6	0·06—0·07	0·5	0·8—1·1		
		C	,, 4	A	**0·45**	**2·8**	(3·25)	**1·0**	**0·09**	**0·45**	**0·78**		
		C	,, 4	R	0·45	2·7—2·9	—	0·9—1·2	0·08—0·10	0·45	0·8—0·9	—	
		C	,, 5	A	**0·5**	**2·70**	(3·2)	**0·8**	**0·10**	**0·5**	**0·75**	—	
				R	0·5—0·55	2·6—2·8	—	0·7—0·9	0·10—0·12	0·5	0·67—0·78	—	
75	WM. ROBERTS (TIPTON), LTD., TIPTON.	H?	"T.G." No. 1 Foundry	A	**0·05**	**3·00**	**3·05**	**3·6**	**0·012**	**1·4**	**0·5**	As, Cu, Cr, Ni, etc., "practically none found in T.G. iron"	"Regret furnaces have been closed down for past eight years or so, owing to the abnormally bad state of the iron and steel trades."
		,,	,, ,, 3 Foundry	A	**0·06**	**2·80**	**2·86**	**3·4**	**0·024**	**1·4**	**0·44**		
		,,	,, Silky or Silvery.. ..	A	trace	**2·96**	**2·96**	**4·40**	**0·012**	**1·5**	**0·5**		
76	BRADLEY & FOSTER, LTD., DARLASTON.	CR	I.X.L.C.B.R. typical specfns. ..	A	—	—	**3·10**	**1·50**	**0·08**	**0·38**	**1·00**	—	"A refined iron for strength and toughness. For locomotive and other heavy cylinders, chilled castings, as mixing iron for motor cylinders, etc. Particularly successful for certain types of acid and heat-resisting castings."
		CR	,, ,, ..	A	—	—	**3·10**	**1·50**	**0·08**	**0·38**	**0·60**	—	
		CR	,, ,, ..	A	—	—	**3·10**	**1·25**	**0·09**	**0·38**	**0·60**	—	
		CR	,, ,, ..	A	—	—	**3·10**	**1·0**	**0·10**	**0·38**	**0·60**	—	
		CR	,, ,, ..	A	—	—	**3·10**	**0·8**	**0·10**	**0·38**	**0·60**	—	
		CR	,, Mottled	A	—	—	**3·00**	**0·75**	**0·12**	**0·38**	**0·60**	—	
		CR	,, White	A	—	—	**3·00**	**0·55**	**0·12**	**0·38**	**0·50**	—	
		CR	,, Special for chilled rolls.	A	—	—	**3·20**	**0 90**	**0·12**	**0·38**	**0·45**	—	
		R	Cylinder Pig R.A.M.	R–A	—	—	**3·10** max.	1·75—2·0	**0·07**	0·60—0·80	1·0—1·25	—	"For mixing to close the grain, toughen, and ensure freedom from 'weeping' under hydraulic test."
		R	,, ,, ...	R–A	—	—	**3·10** max.	1·50—1·75	**0·08**	0·60—0·80	1·0—1·25	—	
		R	,, ,, ...	R–A	—	—	**3·10** max.	1·25—1·50	**0·08**	0·60—0·80	1·0—1·25	—	
					Also supplied "Re alloy pig	in specifications irons, in some	to suit individual requirements cases supplying these with		Ni, Cr and also V and Ti contents."				
		R	Refined Malleable "Dent" ..	R†	—	—	3·0—3·25	0·5—1·3 according to fracture.	0·08—0·12	0·05—0·08	0·15—0·30	—	"Test bars from this iron have given a tensile of 17 tons per sq. in., and a transverse of 32 cwts. per sq. in. on 12 in. between supports."
		,,	Cylinder "Ennerdale"..	R†	—	—	3·0—3·30	1·0—1·3	0·08—0·10	0·13—0·15	0·20—0·30	—	"Guaranteed low in total carbon with a very close fracture, usually a close 6, and tough, due primarily to low total carbon content." For gas, oil and automobile cylinders, assures dense surface which machines well and free from blowholes.

† Made at Cleator, Cumberland. Malleable in general quality Refined Cylinder used as mixing iron for high duty castings. Dense, close fracture, inherently tough.

District "L"—South Staffordshire—*continued.*

Index No.	Firm or Works.	Type.	Designation, Grade or Brand.	COMPOSITION. C. Combd.	C. Gr.	C. Total.	Si.	S.	P.	Mn.	Other Constituents.	Remarks.
76	BRADLEY & FOSTER, LTD., DARLASTON—*continued.*	C	CYLINDER PIG—Low phos. ..	R-A	—	—	3·0—3·20	2·0—2·25	0·07	0·20—0·30	0·6—1·0	—	"Very tough, with a high deflection test, suitable for heavy motor cylinder blocks, to withstand heat and acid, and all castings requiring close grain toughness and good machinability."
		C	,, ,, ..	R-A	—	—	3·0—3·20	1·75—2·00	0·07	0·20—0·30	0·6—1·0	—	
		C	,, ,, ..	R-A	—	—	3·0—3·20	2·0—2·25	0·07	0·10	1·0—1·25	—	
		C	,, ,, ..	R-A	—	—	3·0—3·20	1·75—2·00	0·07	0·10	1·0—1·25	—	
		R	CYLINDER PIG—Special ..	R-A	—	—	3·0	2·25	0·07	0·80—1·0	1·0—1·25	—	
		R	,, ,, ..	R-A	—	—	3·0	2·00	0·07	0·80—1·0	1·0—1·25	—	"Similar to the 'R.A.M.' brand, but rather more phosphorus to promote fluidity."
		R	,, ,, ..	R-A	—	—	3·0	1·75	0·07	0·80—1·0	1·0—1·25	—	"Often used alone, sometimes with 50 per cent. returned scrap for air-cooled type cylinders for motor cycles."
			"In this as in all grades of our refined iron absolute uniformity throughout each consignment is guaranteed."									
			REFINED MALLEABLE—									"Supplied in small pigs."
		R	D.M.R. Grey Mottled	A	—	—	3·20	0·90	0·08	0·07	0·25	—	"Regularity of fracture and analysis. Quality aided by laboratory control. Analyses not mere book figures. Guarantee to supply reasonably to specifications given."
		R	,, Soft Mottled	A	—	—	3·20	0·80	0·08	0·07	0·25	—	
		R	,, Hard Mottled	A	—	—	3·10	0·75	0·10	0·07	0·25	—	
		R	,, Spotted White ..	A	—	—	3·00	0·65	0·10	0·07	0·25	—	
		R	,, White	A	—	—	3·00	0·60	0·12	0·07	0·25	—	"Laboratory figures can be supplied for each consignment."
		R	SWEDISH QUALITY PIG ..	A	—	—	3·20	1·75	0·06	0·05	0·15*	—	"Made in this country to take the place of Swedish."
		R	,, ,, ..	A	—	—	3·20	1·50	0·06	0·05	0·15*	—	"Suitable for using with other irons to promote strength and hardness."
		R	,, ,, ..	A	—	—	3·20	1·25	0·06	0·05	0·15*	—	
		R	,, ,, ..	A	—	—	3·20	1·0	0·06	0·05	0·15*	—	"Supplied principally to makers of chilled crusher jaws, motor cylinders, chilled rolls and for special malleable castings."
			* Also supplied with a manganese content up to 1·0 per cent.									
			STANDARD SERIES—									"The exact mean chemical composition of each of the range figures has been drawn up for calculation purposes."
		R	LP 1	A	—	—	3·10	1·0	0·10	0·35	0·70	—	
		R	LP 1	R	—	—	3·0—3·2	0·90—1·10	0·09—0·11	0·30—0·40	0·60—0·80	—	
		R	LP 2	A	—	—	3·10	1·375	0·09	0·20	0·875	—	
		R	LP 2	R	—	—	3·0—3·2	1·25—1·50	0·08—0·10	0·10—0·30	0·75—1·00	—	
		R	LP 3	A	—	—	3·10	1·75	0·08	0·20	1·125	—	
		R	LP 3	R	—	—	3·0—3·2	1·50—2·00	0·07—0·09	0·10—0·30	1·0—1·25	—	
		R	PM 1	A	—	—	3·0	1·375	0·09	0·70	1·125	—	
		R	PM 1	R	—	—	2·9—3·0	1·25—1·50	0·08—0·10	0·60—0·80	1·0—1·25	—	
		R	PM 2	A	—	—	3·0	1·625	0·08	0·70	1·125	—	
		R	PM 2	R	—	—	2·9—3·0	1·50—1·75	0·07—0·09	0·60—0·80	1·0—1·25	—	
		R	PM 3	A	—	—	3·0	1·875	0·08	0·70	1·125	—	
		R	PM 3	R	—	—	2·9—3·0	1·75—2·00	0·07—0·09	0·60—0·80	1·0—1·25	—	
			DEGASIFIED IRON	—	This firm also supply "a refined iron treated by their degasification process in all grades and compositions, for soundness and density."							
		C	CAPPONFIELD "C.B.," No. 4	A	—	—	3·3	1·1	0·09	0·40	0·70	—	Pig produced under slow melting conditions with low blast pressures. "The temperature of the hearth does not exceed 1,500 deg. C., and although these working conditions are opposed to the modern trend in iron working, it has been proved that the quality of iron so produced is of a particularly high grade, and suitable for all kinds of high-duty castings." Three grades: C.B. = cold blast; W.B. = warm blast; H.B. = hot blast.
		C	,, ,, 5	A	—	—	3·3	0·90	0·12	0·40	0·70	—	
		C	,, ,, 6	A	—	—	3·3	0·70	0·16	0·40	0·70	—	
		C	,, Mottled ..	A	—	—	3·1	0·60	0·18	0·40	0·70	—	
		C	,, White	A	—	—	3·0	0·50	0·20	0·40	0·70	—	
		WB	,, "W.B."† No. 3	A	—	—	3·4	2·00	0·06	0·30	0·80	—	
		WB	,, ,, 4 ..	A	—	—	3·4	1·60	0·06	0·30	0·80	—	
		WB	,, Cylinder ..	A	—	—	3·4	1·80	0·08	0·30	0·80	—	
		WB	,, Low Silicon ..	A	—	—	3·6	0·80	0·07	0·30	0·80	—	

† "A grade of pig-iron produced by working a blast furnace on small output. The slow working in cool air reduces the grain size, lowers the total carbon content, and generally promotes that soundness and strength so essential in all grain roll, valve and cylinder castings."

STANTON

PIG IRON

THE STANTON
IRONWORKS
COMPANY LIMITED
NEAR
NOTTINGHAM

Trade Talk.

Messrs. David Brown & Sons (Huddersfield), Limited, the well-known gear founders, have, in co-operation with their employees, arranged for a group insurance scheme.

The registered office of the Zinc Manufacturing Company, Limited, has been changed from 1, Queen Victoria Street, E.C.4, to 70, Charterhouse Chambers, Charterhouse Square, London, E.C.1.

Messrs. W. E. Burnand & Company, Duo Works, Shoreham Street, Sheffield, have taken over the "Phœnix" electro lifting-magnet business until recently carried on by Messrs. Steel, Peech & Tozer, Limited.

As the result of an explosion of a gas furnace in the Avon Steelworks, Dennistoun, Glasgow, two ironworkers, James Gray and Matthew Keen, were severely injured. They were detained for treatment at the Royal Infirmary.

The Admiralty has placed an order with Messrs. William Gray & Company, Limited, Central Marine Engine Works, West Hartlepool, for two sets of reciprocating engines and boilers for two small vessels required for the Navy.

The Empire Industries Association states in its bulletin that at the end of June over 30 per cent. of the steel workers in this country were out of work. It is also added that over 15 per cent. of our engineering mechanics are unemployed.

Messrs. Hall, Russell & Company, Limited, Aberdeen, launched two trawlers on the same day from their Aberdeen yard. These were built for the Aberdeen Steam Trawling & Fishing Company, Limited, and are the 74th and 75th vessels constructed for that company.

Work is to begin at once on a £100,000 contract secured by the Cleveland Bridge & Engineering Company, Limited, Darlington, for widening the Great Western Railway Company's main line between Leamington Spa and Birmingham. The work will be completed in two years.

Mr. T. L. Price, who, up to 1924, represented Mellard's Trent Foundry Company, Rugeley, has been presented by his present firm, Blackstone & Company, Limited, Stamford, with a suitable souvenir in celebration of the fact that he has attended every Royal Agricultural Show since 1871.

The first of 30 new engines left the works of Messrs. Beyer, Peacock & Company, Limited, Gorton, Manchester, recently, to take up heavy coal and mineral duties on the London Midland and Scottish Railway. They are of the Garratt type, and weigh, when loaded with coal and water, 151 tons.

A National Metal Congress, in which several societies are participating, is to be held at the Hotel Stevens, in Chicago, U.S.A., from September 22 to 26. The American Society of Steel Treating has arranged a technical programme, which includes Papers on nickel-chromium stainless steels, steel ingots and mould design.

An order for three 50,000-kilowatt turbo-alternators has been placed by the Electricity Board with Messrs. C. A. Parsons & Company, Limited, Newcastle-upon-Tyne. The firm have also secured an order for an 18,750-kilowatt turbo-alternator for the Chelsea power station of the London Underground Railways.

An order has been placed with Messrs. Lithgows, Limited, Port Glasgow, to build a passenger and cargo vessel for the Jamaica Direct Fruit Line. The vessel will have a gross tonnage of about 6,000, and her propelling machinery will consist of quadruple-expansion engines to be built by Messrs. David Rowan & Company, Limited, Glasgow.

The Borough Engineer (Mr. S. E. Burgess) stated at a meeting of the Middlesbrough Corporation Plant Committee last week that a start would probably be made in February with the new bridge across the River Tees at Newport. He thought that the Corporation would be in a position in October to invite tenders for the bridge's construction.

Messrs. John Allan & Company, Glenpark Road, Glasgow, a firm carried on by the late Mr. John Twaddle and afterwards by his trustees, has been acquired by John Allan & Company (Glenpark), Limited, as also has the business of Mr. Robert Twaddle, Barrland Street, Glasgow. Mr. Robert Twaddle has assumed the position of managing director of the new firm.

Arrangements are being made to restart one of the fourteen retorts at the Bussey Coal Distillation Company's plant at Glenboig about the middle of September. The plant has been closed down since the end of last year, and it is understood that the retort which is being restarted is for the purpose of testing certain alterations and improvements in design and process.

The contract for the floating dock for the Wellington (New Zealand) Harbour Board has been placed with Messrs. Swan, Hunter & Wigham Richardson, Limited, Wallsend-on-Tyne. The dock, which has been the subject of lengthy negotiations, will be 540 ft. long, 117 ft. broad, and will have a lifting capacity of 17,000 tons. Messrs. Swan, Hunter & Wigham Richardson, Limited, built the Singapore dock, the largest floating dock in the world.

It is understood that Messrs. George Cohen, Sons & Company, Limited, of Commercial Road, London, E., have purchased the locomotive works of Messrs. Kerr, Stuart & Company, Limited, Stoke-on-Trent. At present the works are employing only a skeleton staff in order to complete outstanding contracts. Under the new management arrangements have been made for the manufacture of spare parts for engines manufactured by the company which are in use in Great Britain and abroad. The works cover 26½ acres of ground. In recent years Messrs. George Cohen, Sons & Company, Limited, have purchased a number of other engineering firms. Kerr, Stuart & Company, Limited, was registered in 1910. The balance-sheet at July 31, 1929, showed that the share capital was £420,000. A net loss of £15,906 for the year was reported.

Government contracts recently placed include the following:—War Office: Old cast iron, T. W. Ward, Limited, London; nickel, H. Gardner & Company, Limited, Clydach, Swansea; steel rods, S. Fox & Company, Limited, Sheffield; round steel, Hadfields, Limited, Sheffield; goods wagons, Rolling Stock Company, Limited, Darlington. Air Ministry: Cast-iron pipes, Stanton Ironworks Company, Limited; corrugated sheets, John Summers & Sons, Limited, Shotton; steel drums, Steel Barrel Company, Limited, Uxbridge. Crown Agents for the Colonies: Locomotives, Hunslet Engine Company, Limited, Leeds; Motor Rail & Tram Car Company, Limited, Bedford; Vulcan Foundry Company, Limited, Newton-le-Willows; locomotive boilers, Kitson & Company, Limited, Leeds; metal castings, Anti-Attrition Metal Company, Limited, London; phosphor bronze metal, Phosphor Bronze Company, Limited, London, S.E.; pipes, Cochrane & Company, Limited, Middlesbrough; J. Spencer, Limited, Wednesbury; rails and fishplates, F. Theakston, Limited, London; United Steel Companies, Limited, Workington; steel, P. & W. MacLellan, Limited, Glasgow; steel sheets, Wolverhampton Corrugated Iron Company, Limited, Wirral; steel water mains, British Mannesmann Tube Company, Limited, London; steelwork, Braithwaite & Company, Limited, London; Dorman, Long & Company, Limited, Middlesbrough; A. Findlay & Company, Limited, Motherwell; Tees Side Bridge & Engineering Company, Limited, Middlesbrough; E. Wood & Company, Limited, Manchester; tools, English Steel Corporation, Limited, Manchester; tubes, Stewarts & Lloyds, Limited, Glasgow; wagons, Birmingham Railway Carriage & Wagon Company, Limited, Birmingham; R. Hudson, Limited, Leeds; Charles Roberts & Company, Limited, Horbury Junction.

Personal.

Mr. T. R. Dunkerley, works manager at Dorchester Foundry, has celebrated his golden wedding.

Lord Melchett, chairman of Imperial Chemical Industries, Limited, and Sir Harry McGowan, President and deputy chairman of the company, left Southampton last week for a short business visit to the United States.

The many friends of Mr. James Ellis, a past-President of the Institute of British Foundrymen, will learn with regret that he has been confined to his room for several weeks. He may receive letters of a non-business character at his home at 20, Lambourne Road, Clapham, London, S.W.4. We are sure that Mr. Ellis has good wishes of the entire foundry industry for a speedy recovery.

Councillor Gavin Riddett, who has been foreman engineer at the Glengarnock blast furnaces, which now belong to Messrs. David Colville & Sons, Limited, has just retired. The staff and employees have presented him with a pair of binoculars. Mr. George M'Cracken, who has been foreman at the furnaces for 29 years, has also retired, and to him the employees and staff presented an umbrella and a wallet of bank notes.

Obituary.

Mr. John Pugh Gregory, for many years manager of the contract department of the British Thomson-Houston Company, Limited, Rugby, died recently, aged 54. Mr. Gregory was an active member of several of the committees of the British Electrical and Allied Manufacturers' Association.

Mr. George Gall Sim, deputy-chairman of Messrs. Vickers-Armstrongs, Limited, and of Messrs. Vickers, Limited, who retired from a career of great distinction in the Indian Civil Service a few years ago to enter business life, died on August 20, at Elgin, at the age of 52. Mr. Sim was appointed secretary of Vickers, Limited, in July, 1926, becoming deputy-chairman of the company and of Vickers-Armstrongs, Limited, in 1929. He was created C.I.E. in 1920 and C.S.I. in 1926.

Mr. Charles Courtenay Wharton, a distinguished member of the staff of the British Thomson-Houston Company, Limited, Rugby, died recently, aged 59. Mr. Wharton joined the British Thomson-Houston Company on its formation in 1896-97, being first engaged in the testing of transformers and other apparatus. Later he joined the technical department, and eventually, in 1919, was appointed assistant chief engineer. He was closely concerned with the work of the British Engineering Standards Association and the British Electrical and Allied Manufacturers' Association.

Mr. James Neill, founder and chairman of Messrs. James Neill & Company (Sheffield), Limited, of Composite Steelworks, Napier Street, Sheffield, and a director of the Tinsley Rolling Mills Company, Limited, Tinsley, died on Sunday, August 17, in his 73rd year. He had been ill only a short time. Mr. Neill had an interesting business career. He started life as an accountant, and served in that profession for some years. But, although successful in this and other Sheffield businesses, he felt that the crucible steel industry offered the best prospects of a career, and about 42 years ago he leased crucible melting furnaces in Bailey Street, Sheffield, and began to make crucible steel without any practical knowledge or experience of the trade and without a single customer. But by close application to business the undertaking grew. Mr. Neill made bold experiments in modern steel development, in which he was afterwards joined as co-directors by his sons, Colonel F. A. Neill and Mr. Wilfred M. Neill; and also by Mr. Robert A. Neill. In 1908 he moved into larger premises in Napier Street. He adopted as one of his specialities the material known as combined iron and steel, which, though still an important branch of the business, is only one of the many products of the firm. He was a pioneer of gas-fired crucible furnaces. About 20 years ago the firm installed plant for making "Eclipse" hack-saw blades, of which trade up to then the United States had almost a monopoly. In this, as in every other branch of their business, Mr. Neill made a special point of the firm controlling virtually the whole of the manufacture from the raw material to the finished article. Another important branch Mr. Neill inaugurated was the manufacture of permanent magnets for magnetos. James Neill & Company, Limited, was one of the several British firms which responded to the appeal of the Government to take up the manufacture of magnets at a critical moment during the war, and although the work was difficult and intricate, involving much scientific research and experiment, the task was achieved in a surprisingly brief time. The value of Messrs. Neill's service to the country in this matter was well expressed in a letter of acknowledgment from the Air Board. In this communication the writer said that without the thorough investigations and careful experimental work which the firm had carried out, it would not have been possible to produce such successful magnets as had been supplied to the department, and added that the personal efforts of Mr. James Neill himself had also been largely responsible for making this country to-day independent of Germany in this branch of industry. A native of Sheffield, Mr. Neill was in 1901 elected on the City Council as representative for Eccleshall, and sat for three years. He was Master Cutler in 1923, and in February, 1928, his name was added to the list of Sheffield magistrates.

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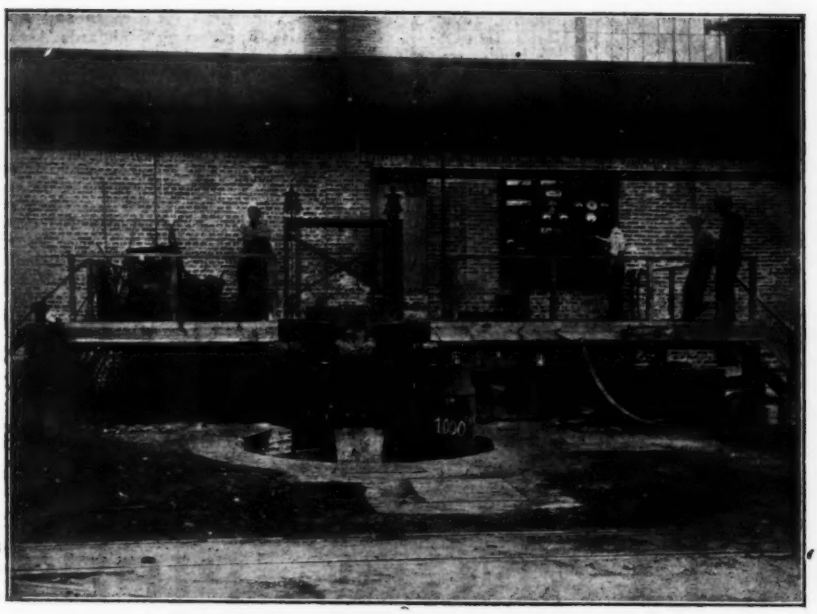

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—In accordance with tradition, on the North-East Coast, this period of the year has long been observed as the annual holiday of the workers in the iron industry, and on this occasion has been extended, by reason of the prevailing trade depression, beyond the customary limits. There was, consequently, no regular meeting of the Cleveland ironmasters last week, and thus no opportunity was afforded of testing the effects of the recent drastic reduction in pig-iron prices as announced in a previous issue. With, however, the close of the month in immediate prospect, it may be possible to forecast to a limited extent the probabilities of the changed conditions under which markets will operate in the near future, in view of the revised prices now in force. An important eventuality in this direction may be the probable cessation of competition from Midland furnaces, and further encourage buyers on forward account to place orders on a more extensive scale than has recently been experienced. At all events, since the cuts were notified there has been a little more inquiry for Cleveland iron from home consumers, but few orders have yet been placed, and no real expansion is anticipated until after the end of the month. Exporters report few opportunities of business abroad even at the reduced figures now ruling, which are as follow:—No. 1 Cleveland foundry iron 66s., No. 3 G.M.B. 63s. 6d., No. 4 foundry 62s. 6d., No. 4 forge 62s. per ton.

Hematite producers on the North-East Coast now express a more hopeful view of market prospects than has been observable hitherto, and though stocks in hand are still on a formidable scale, the tone throughout is much less despondent than has recently been noted. Thus, although merchants are still prepared to cut prices for acceptable business, the recognised quotations amongst the makers are firmly held. 71s. for East Coast mixed numbers and 71s. 6d. for No. 1 quality. On the North-West Coast, Bessemer mixed numbers are still quoted 70s. per ton at works.

LANCASHIRE.—The close of the holiday month in this area has been marked by a modified revival of demand for foundry pig, and some local sellers are reported to have booked a bigger aggregate tonnage of late, with, in one or two instances, a disposition to display a little more interest in forward contracts. Staffordshire and Derbyshire No. 3 is quoted at 72s. per ton, and Scotch brands 93s. to 94s., all per ton delivered local stations.

THE MIDLANDS.—Many of the ironfounders in the Birmingham area still complain that trade is bad, although here and there it is found that the light-castings trade is picking up to some extent. The zone prices delivered to local stations are 70s. for Northants No. 3 and 73s. 6d. for Derbyshire and Staffordshire No. 3. Small supplies of Lincolnshire No. 3 are coming into the district at the Derbyshire rate, and Scotch iron is on offer at 93s. 6d. to 97s. 6d. delivered.

SCOTLAND.—The market for Scotch pig-iron remains quiet, with local demand continuing on a hand-to-mouth scale, buyers, apparently, lacking confidence to place forward contracts. The price of No. 3 quality remains unaltered at 76s. 6d., f.o.t. furnaces, with an extra of 2s. 6d. per ton for No. 1 quality.

Finished Iron.

In common with all other departments of the iron and steel trade, demand for finished material continue inactive, and it is only in connection with marked bars that there is any life in the market. The makers of this quality remain fairly well occupied and adhere to their price of £12 10s. Crown quotations vary from £10 to £10 5s., and makers in Derbyshire and Lancashire are competing with Staffordshire mills for this type of business. Orders of any note, however, are almost entirely absent. With regard to nut and bolt iron, the local figures are from £9 to £9 5s., but here, again, little business is possible, while Belgian No. 3 bolt iron can be obtained at between £5 12s. 6d. and £5 17s. 6d. delivered this district.

Steel.

Markets for semi-products have been, for some time past, in a state of suspended animation, but it is satisfactory to note that most of the business in circulation is being absorbed by British works. At Sheffield conditions are very quiet, and dealings in both acid and basic billets are on a small scale. Wire rod makers are feeling the effect of Continental competition acutely. Prices, which are unchanged, are as follow:—Siemens acid billets, £9 10s.; basic billets, soft, £6 10s.; medium, £7 12s. 6d.; hard, £8 2s. 6d. to £9 12s. 6d.; wire rods, acid, £12 5s. to £12 10s.; basic, soft, £8; medium hard, £9 15s. to £10; hard, £10 10s. to £11; steel hoops, £9 15s. The tinplate market is still slack, with 18s. basis again quoted for coke quality, net cash f.o.b. Welsh ports.

Scrap.

As all the consuming works on the North-East Coast are idle for the current holiday fortnight, supplies of foundry scrap metal are temporarily suspended and business is at a standstill. Prices, therefore, have undergone no change, with heavy cast iron, ordinary quality, quoted 55s. and machinery grade 37s. 6d. per ton. There is not much change in the position of the iron scrap trade in Scotland. Outlets are still limited, but consumers now appear to be a little more interested in purchasing at current figures, which are very low. Approximate current quotations are as follow:—Machinery quality in pieces not exceeding 1 cwt. is indicated at around 63s., with ordinary cast iron to the same specification at 57s. 6d. The above prices are all per ton delivered f.o.t. consumers' works.

Metals.

Copper.—Variations in values of warrant copper over the past week were only of fractional extent; quotations remaining remarkably steady throughout, and closing a fairly steady tendency, and the margin between rough and electrolytic is little more than £4. Stocks of rough copper in this country are about 5,000 tons, a somewhat inadequate figure for trading purposes. Customs smelters in the United States recently reduced values by 25 points, and some 3,000 tons were sold at 10.75 cents, cheap offers also being received in Europe.

Closing quotations :—

Cash.—Thursday, £47 to £47 2s. 6d.; Friday, £46 17s. 6d. to £46 18s. 9d.; Monday, £46 16s. 3d. to £46 18s. 9d.; Tuesday, £46 16s. 3d. to £46 18s. 9d; Wednesday, £46 16s. 3d. to £46 17s. 6d.

Three Months.—Thursday, £47 3s. 9d. to £47 5s.; Friday, £47 to £47 1s. 3d.; Monday, £47 to £47 1s. 3d.; Tuesday, £46 18s. 9d. to £47; Wednesday, £46 18s. 9d. to £47.

Tin.—Movements in standard tin values of late have also been of unimportant range, while the weekly turnover is reported of moderate proportions Consumption in America, although, perhaps, a little better, is still well under normal, and upon developments across the Atlantic depends the chance of tin reaching a better level. Some revival in trade during the autumn would no doubt have its effect on the tin market, but nothing sensational is expected.

Official closing prices :—

Cash.—Thursday, £134 12s. 6d. to £134 15s.; Friday, £134 7s. 6d. to £134 10s.; Monday, £134 to £134 2s. 6d.; Tuesday, £132 15s. to £132 17s. 6d.; Wednesday, £133 7s. 6d. to £133 10s.

Three Months. — Thursday, £136 5s. to £136 7s. 6d.; Friday, £135 17s. 6d. to £136; Monday, £135 10s. to £135 12s. 6d.; Tuesday, £134 7s. 6d. to £134 10s.; Wednesday, £134 17s. 6d. to £135.

Spelter.—Following a reactionary tendency values recovered, but consumptive buying is far from satisfactory, even high-grade zinc being in poor demand. While it is generally understood that agreement has been reached among producers, details have yet to be arranged regarding curtailment of output.

Daily fluctuations :—

Ordinary. — Thursday, £15 15s.; Friday, £15 18s. 9d.; Monday, £15 15s.; Tuesday, £15 12s. 6d.; Wednesday, £15 17s. 6d.

Lead.—The market has fluctuated within narrow limits, a fair business being done with consumers in Europe. Although values are well held by the group, lead is plentiful, and some opinions look for a setback.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £18 6s. 3d.; Friday, £18 6s. 3d.; Monday, £18 5s.; Tuesday, £18 5s.; Wednesday, £18 1s. 3d.

B.S. Specifications for Bronze and Aluminium.—The British Engineering Standards Association has issued five new Specifications for non-ferrous metals. Two of these (Nos. 382 and 383) deal with 2/10/88 bronze (gun-metal) ingots and castings respectively. The alloy corresponds very closely with that commonly known as "Admiralty gun-metal," and the chemical composition and physical properties of the material are laid down. Another specification (No. 384) is for hard-drawn phosphor-bronze wire, primarily for armature binding, and covers two grades of wire. It provides for the chemical composition of the material and specifies margins of manufacture and physical tests, including a test for the adherence of the coating of tinned wire. The other two specifications relate to pure aluminium, and deal with tubes (No. 385) and bars and sections (excluding wire bars) (No. 386). The chemical composition and physical properties of the finished material are specified, and clauses giving permissible margins of manufacture for the finished tubes, bars and sections are included. Copies of the five new Specifications may be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria Street, London, S.W.1. Price 2s. 2d. each, post free.

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PETER—WITH ONE EXCEPTION

With one exception Peter is an ordinary little fellow. Chubby, likeable, just five-and-a-half, full of life and fun, and on occasions—be it admitted—of naughtiness. Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice-Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception. Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-halfs. However, he's a stout lad is Peter, and he's making great progress.

Would you like to know more about him? How, in spite of his "One Exception," he is being educated and, when older, technically trained and usefully employed. There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.

Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received.

Here's a suggestion. Your eyesight is worth 3d. a year to you. Send Peter and his handicapped pals 3d. for every year you've had it. Now, please, in case it slips your memory. Good idea?

The Chairman,

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